

Moving Toward a Lead-Safe America

**A Report to the Congress
of the United States**

*Prepared in Response to Section 1061(a)
of the Housing and Community Development Act of 1992*

**U.S. Department of Housing And Urban Development
Office of Lead Hazard Control
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Overview

The Department of Housing and Urban Development and other government agencies have launched a major new effort to eliminate childhood lead poisoning as a major disease. This report explains the work being done to reach that goal.

Childhood lead poisoning is linked to reduced intelligence, low attention span, reading and learning disabilities, juvenile delinquency, behavioral problems, and other adverse health effects. Over the past 20 years, the removal of lead from gasoline, food canning and other sources has been successful in reducing population blood lead levels by over 80%. However, nearly 1 million children still have excessive levels of lead in their blood, making lead poisoning a leading childhood environmental disease. Lead-based paint in housing is the major remaining source of exposure and is responsible for most cases of childhood lead poisoning today.

The lead poisoning prevention campaign was authorized by Congress under Title X of the 1992 Housing and Community Development Act and includes:

- notification and disclosure of lead-based paint hazards during sales and leasing transactions of certain older properties, enabling parents to get the information they need to protect their children;
- grants to States and local governments to control lead-based paint hazards in low-income privately-owned dwellings;
- technical guidance to ensure that lead hazard control work is done safely and efficiently;
- State certification programs to help owners find trained, qualified, licensed abatement contractors and inspectors;
- consensus lead safety standards (developed by a Task Force representing realtors, parents,

owners, bankers, non-profit housing providers and many others) designed to be workable in private housing and protective of children's health;

- occupational health standards to protect construction workers and their children; and
- other public education efforts

This report explains how the Department of Housing and Urban Development (HUD), the Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC) and other government agencies have empowered communities to control residential lead-based paint hazards without adversely affecting low-income housing affordability and availability. It shows how housing is being made lead-safe *before* a child is poisoned. Under the HUD grant program, communities typically develop local strategies that combine financing for lead hazard control work with other initiatives, such as homeownership, jobs and job training, and other community development activities. Together, these activities ensure that the future of America's children will not be blunted by lead poisoning.

Title X authorizes HUD to take a preventive, housing-based approach to the problem. This report explains how HUD is coordinating with EPA, CDC and the medical community to combine this approach with existing blood lead screening programs to ensure that those children who are poisoned are identified and treated. CDC administers a national program that screens high-risk children for elevated blood lead levels. The program ensures that lead-poisoned children receive medically-appropriate and timely case management services.

Measuring Success

The National Health and Nutrition Examination Survey (NHANES) monitors blood lead levels (among other health measures) of a large representative sample of the U.S. population.

Moving Toward A Lead-Safe America

Preliminary data from Phase 2 of the third NHANES, covering the years 1991 to 1994, show that while blood lead levels have declined in recent years, approximately 930,000 children still have too much lead in their bodies. Phase 1 of NHANES showed that 1.7 million children in 1988-1991 had too much lead in their bodies. The data also show that for the at-risk populations where HUD, EPA and CDC have targeted their work, the absolute decline in blood lead levels is far greater than for the general population of children. In short, the data show that we are making progress, but more remains to be done. HUD has also launched an in-depth scientific evaluation of its first-round grantees. With over 2,500 housing units enrolled, it is the largest, most comprehensive study of residential lead hazard control ever initiated. A recent interim report found

that the work resulted in a decline of 85% to 99% in the average dust lead levels on windows in both occupied and vacant units. On floors, average lead dust levels declined 23% and 91% in occupied and vacant units, respectively. Most of the reductions in dust lead levels persisted after 6 months. (Dust is the main exposure pathway for today's children.) Future reports will follow the effect of the treatments on dust lead levels and on children's blood lead levels over at least a 3-year period.

Copies of both the CDC's NHANES report (published in *Morbidity and Mortality Weekly Report*, February 21, 1997) and the HUD evaluation report can be obtained from the HUD Office of Lead Hazard Control at 202-755-1785.

Federal Agency Internet Website Information

HUD has made all of its lead-related pamphlets, guidelines, task force reports, regulations and other materials available on the internet at:

<http://www.hud.gov/lea/leahome.html>

Other Web Sites

With HUD support, a nationwide listing of qualified inspectors, risk assessors and abatement contractors is also available via the internet to enable citizens to locate qualified personnel at:

<http://www.leadlisting.org>

EPA has also made its lead-related pamphlets and technical reports at:

<http://www.epa.gov/opptintr/lead/index.html>

Reports on occupational exposures to lead are available from the National Institute for Occupational Safety and Health at:

<http://www.cdc.gov/niosh/ables.html>

The National Lead Information Center internet address is:

<http://www.nsc.org/ehc/lead.htm>

Documents Available on HUD'S Internet Website

- Moving Toward a Lead-Safe America: A Report to the Congress of the United States, February 1997
- Lead-Based Paint Hazard Notification, Evaluation, and Reduction: HUD's Proposed Rule for Federally Assisted and Federally-Owned Housing, including Questions & Answers supplement (Title X, Sections 1012 & 1013), including Regulatory Impact Analysis (Cost/Benefit Analysis)
- HUD Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing, June 1995
- Lead-Based Paint Disclosure Rule (Title X, Section 1018)
- EPA/HUD/CPSC Lead Hazard Information pamphlet: "Protect Your Family From Lead in Your Home" May 1995, English and Spanish
- Guidance on the Lead-Based Paint Disclosure Rule, Part I, August 21, 1996
- Guidance on the Lead-Based Paint Disclosure Rule, Part II, December 5, 1996
- FACT SHEET: "Lead Hazard Prevention in Homes Pamphlet Released" March 1996
- FACT SHEET: "EPA and HUD Move to Protect Children from Lead-Based Paint Poisoning, Disclosure of LBP Hazards in Housing" March 1996
- Sample Disclosure Form for Target Housing Sales and for Target Housing Rentals and Leases (2 forms- English)
- Sample Disclosure Form: Declaracion de Informacion por Arrendadores sobre Pintura a Base de Plomo y/o Peligros de la Pintura a Base de Plomo
- Sample Disclosure Form: Declaracion de Informacion por los Vendedores sobre Pintura a Base de Plomo y/o Peligros de la Pintura a Base de Plomo
- EPA Requirement for Lead-Based Paint Activities in Target Housing and Child-Occupied Facilities: Final Rule, August 1996 (EPA TSCA, Title IV, Sections 402 & 404)
- Addressing the Exposure Hazard from Lead in Imported Vinyl Miniblinds, August 1996
- "The Economics of Lead-Based Paint Hazards in Housing," Lead Perspectives Magazine, September/October 1996. Article written by David E. Jacobs, Director of the HUD Office of Lead Hazard Control
- "The Health Effects of Lead on the Human Body," Lead Perspectives Magazine, November/December 1996. Article written by David E. Jacobs, Director of the HUD Office of Lead Hazard Control
- XRF Performance Characteristic Sheets (PCS) Manufacturer and XRF Instrument
 - * TN Technology, Inc., Pb Analyzer (512) 388-9211
 - * Scitec Corp., MAP-3 and the MAP 4 (510) 849-5802
 - * Warrington, Inc., Microlead I Revision 4 (512) 251-7771
 - * Princeton Gamma-Tech, Inc., XK-3 (609) 24-7310
 - * Niton Corp., XL (800) 875-1578
 - * Radiation Monitoring Devices, Inc. LPA-1 (800) LEAD-RMD

Introduction

This report has been prepared in response to section 1061(a) of the Residential Lead-Based Paint Hazard Reduction Act, which is Title X of the 1992 Housing and Community Development Act (Public Law 102-550).

Organization of the Report

Following the overview and introduction, the four parts of the report are organized in accordance with Section 1061(a).

Part 1 describes the Department's progress in implementing the various programs authorized by Title X. Accomplishments of the Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), the Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health (NIOSH) and the General Accounting Office (GAO) are described, as are those of HUD.

Part 2 describes the results of research carried out in accordance with subtitle D of Title X.

Part 3 summarizes recent health and environmental studies on childhood lead poisoning.

Part 4 provides an estimate of the amount of Federal assistance spent annually on lead hazard evaluation and reduction.

References are shown by author in the text and listed at the end of the report.

This report does not recommend any legislative initiatives. The Department will include such recommendations in its legislative requests.

Childhood Lead Poisoning

Average blood lead levels in the U.S. declined over 80 percent between the late 1970s and the early 1990s, mostly because of the deleading of gasoline and the banning of lead solder in food cans and other containers. Nevertheless, lead exposure still remains

a major environmental disease in children. The third National Health and Nutrition Examination Survey (NHANES III, phase 1, 1988-1991) showed that 1.7 million children 1 to 5 years of age (8.9 percent of that age group) had blood lead levels that exceeded the level of concern set by the Centers for Disease Control and Prevention (CDC), which is 10 µg/dL (micrograms of lead per deciliter of blood). Higher childhood blood lead levels were associated with lower household income, residence in large urban areas, non-Hispanic black race, and living in older homes. For example, among young non-Hispanic black children living in large central cities, 36.7 percent had blood lead levels above 10 µg/dL (Brody 1994, Pirkle 1994). Recently-published data from Phase 2 of NHANES III (1991-1994) shows that the number of children above 10 µg/dL had declined to about 930,000 and that 22 percent of African-American children had blood lead levels above 10 µg/dL (CDC 1997).

Although this report primarily addresses lead exposure among young children, adult exposure is also of concern. Based on the NHANES III (Phase 1) survey data, it is estimated that approximately 700,000 adults aged 20-74 had blood lead levels equal to or exceeding 25 µg/dL, which is the threshold level used in the Adult Blood Lead Epidemiology and Surveillance (ABLES) program operated by the National Institute of Occupational Safety and Health (NIOSH).

Lead Toxicity

Lead is a powerful toxicant with no known beneficial purpose in the human body, unlike other metals like iron or zinc. Young children are at greater risk from exposure to lead than adults because their bodies and central nervous systems are still developing. Also, young children normally engage in frequent hand-to-mouth activity that can bring them into greater contact with lead in dust and soil. Finally, children absorb and retain a larger percentage of ingested lead per unit of body weight than adults.

Health effects at high levels of exposure can include severe retardation, coma, even death, although that is now rare. More common are less obvious neurological and behavioral effects resulting from lower levels of exposure. Recent research indicates that lead exposure is linked to reduced intelligence and attention span, reading and learning disabilities, and behavioral problems such as juvenile delinquency.

Comprehensive information on lead poisoning can be found in Part 3 and:

- *The Nature and Extent of Lead Poisoning in Children in the United States: A Report to Congress* from the Agency for Toxic Substances and Disease Registry (ATSDR 1988a)
- *Measuring Lead Exposure in Infants, Children, and Other Sensitive Populations* from the National Academy of Sciences (NAS 1993)

Controlling Exposure to Lead

Today the most widespread source of lead exposure in the environment of U.S. children is old lead-based paint that was applied to residential buildings before the 1978 ban on residential leaded paint by the Consumer Product Safety Commission. To significantly reduce those exposures, the nation must address lead-based paint hazards in housing. That is the goal of Title X and the subject of this report.

There are other less common sources of lead in the environment. They are not directly considered in this report, although the various public education activities that are mentioned here usually take them into account. These include lead in drinking water (usually from lead in old pipes and soldered joints), imported ceramic tableware with lead glaze, old toys or furniture painted with leaded paint, home hobbies that involve lead, clothing that has been contaminated at the work place, some ethnic home remedies, and other materials.

The residential lead-based paint hazards of greatest concern are deteriorated lead-based paint (i.e.,

peeling, flaking paint that may be picked up and eaten by young children) and the contaminated house dust and bare soil it contaminates. If proper precautions are not taken, renovation, remodeling and maintenance, including repainting, can generate large amounts of lead-contaminated dust and soil.

HUD and EPA estimate that in 1990 at least 19 million homes had lead-based paint hazards, of which at least 4 million were occupied by families with young children under age 6 (HUD 1990; EPA 1995). Over time, the specific homes with these conditions change, as families age or move, and as buildings deteriorate or are renovated and maintained. The older the home, the more likely it is to have lead-based paint hazards. Also, older homes have a greater extent of hazards (as measured, for example, in square feet of deteriorated lead-based paint) and a greater concentration of lead in paint, dust and soil.

In Title X, the Congress stated that the nation needs the following elements to successfully address lead-based paint hazards in housing:

- an informed public, aware of lead hazards in housing and knowledgeable about how to protect themselves and their children;
- practical methods of hazard identification and control that are effective, safe, and affordable;
- trained and certified (licensed) inspectors, risk assessors, abatement contractors and workers, as well as certified laboratories;
- available financing and liability insurance for property owners and contractors; and
- organizations and processes at the State and local levels to administer lead-based paint programs.

Major Accomplishments

HUD, EPA, CDC, NIOSH and the Occupational Safety and Health Administration (OSHA) have acted aggressively to reach the goals set by Title X.

Following are some of the important accomplishments to date:

- **Lead Hazard Control Grant Program.** In fiscal years 1992-1995, HUD awarded a total of \$280 million to 56 State and local governments to reduce lead hazards in approximately 30,000 privately owned, low-income housing units. These grants include funds from appropriations

made in fiscal years 1992, 1993, and 1994. FY 1995 funds were rescinded. In FY 1996, an additional \$55 million was awarded to 20 grantees. Table 1 shows that the Department has always received many more requests for assistance than it can fund. For example, in 1996, 73 applicants submitted proposals requesting a total of \$231 million; \$55 million was appropriated.

Table 1.
Number of HUD Lead-Based Paint Grantees

Fiscal Year	Total Applications Received	Applicants Funded	Percentage of Applicants NOT Funded
1992	56	10	82%
1993	64	19	70%
1994	60	35	42%
1995	—	Rescission	—
1996	73	20	63%

The grant program supports paint inspections and risk assessments, low-cost interim controls, longer term abatements, public education in high risk neighborhoods, and related activities. Grantees have the flexibility to choose the hazard control methods that work best locally, provided the work is done safely. For example, in Baltimore the grant program works in concert with another local program to reconnect fathers with their families by providing them with good jobs (and job training) in lead abatement work. In Manchester, Connecticut the HUD lead program provides a way for first-time low-income homebuyers to finance lead hazard control work in their newly-purchased homes.

Finally, an intensive scientific evaluation is under way to determine the effectiveness of the local strategies. Preliminary findings will be reported annually beginning in February 1997; the final report is planned for the year 2000.

State Certification Programs. In the initial year of the HUD grant program, only one State had a program to certify individuals and firms performing lead-based paint activities to ensure that the work was done correctly. As of this writing, 26 States have programs in operation or have passed enabling legislation. This progress is due in large part to the requirement in the grant program that hazard evaluation and control work be done by certified contractors.

HUD and EPA have a combined grant program that assists States in the development of certification (licensing) programs. Thus far, the two agencies have awarded \$36.2 million for this purpose to 46 States, the District of Columbia, and 27 Native American Tribal Nations. In the spirit of governmental streamlining, HUD and EPA consolidated two separate programs into one program now administered by EPA.

To set national standards for the certification process, EPA published final regulations on August 29, 1996 regarding accreditation of training providers and certification of lead-based paint inspectors, risk assessors, project designers, and abatement supervisors and workers. The regulations implement sections 402 and 404 of the Toxic Substances Control Act under Title X authority.

Notification and Disclosure During Real Estate Transactions. On March 6, 1996, HUD and EPA jointly published a final regulation to ensure that the public receives the information necessary to prevent lead poisoning in homes that may contain lead-based paint hazards. The regulation implements section 1018 of Title X. Beginning in the fall of 1996, buyers and renters of homes built before 1978 will receive certain information from sellers and landlords at the time of the sale or lease. The information includes a pamphlet on lead hazards and what to do about them, a warning statement, a disclosure of any known lead-based paint hazards on the property, and actual test reports if available. If they wish, buyers will get 10 days (or other mutually-agreeable period) to test for lead-based paint hazards at their expense. This regulation does not require anyone to test for or abate lead hazards if they choose not to.

The regulation is supported by the National Association of Realtors, whose President joined the Secretary of HUD and the Administrator of EPA in announcing the rule. Other groups supporting the regulation included the Consumer Federation of America, the United Parents Against Lead (an organization representing the parents of lead-poisoned children), the National Multi Housing Council, the Alliance to End Childhood Lead Poisoning, and the Apartment Owners Association.

Lead Hazard Information Pamphlet. In August 1995, EPA published an illustrated pamphlet entitled "Protect Your Family From Lead in Your Home." Prepared pursuant to section 406(a) of the Toxic Substances Control Act as amended by Title X, the pamphlet is being used to educate families about lead hazards throughout the nation. This is

the pamphlet that must be given to home buyers and renters under the notification and disclosure requirements described above (unless a State or local pamphlet is used in its stead, as provided for in the section 1018 regulation). HUD, EPA and the National Association of Realtors have joined forces to distribute 750,000 pamphlets to realtors across the country as part of a major outreach campaign.

Comprehensive Technical Guidelines. In August 1995, HUD published the "Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing," which were called for by section 1017 of Title X. This 700-page document is a comprehensive compendium of information on how to identify and reduce lead-based paint hazards effectively, safely, and efficiently. The Guidelines have been well received. Over 15,000 copies have been distributed to date.

Task Force Report. In July 1995, the Task Force on Lead-Based Paint Hazard Reduction and Financing released its recommendations in a report titled "Putting the Pieces Together: Controlling Lead Hazards in the Nation's Housing," which was distributed to all Members of Congress. The purpose of the Task Force was to develop a series of recommendations to harness private market forces and better target public resources to finance and control lead-based paint hazards in the nation's housing stock before children are poisoned. The 40-member Task Force was appointed by Secretary Henry Cisneros in 1993 pursuant to section 1015 of Title X. Its members represented landlords, parents, tenants, lending institutions, mortgage insurers, property liability insurers, nonprofit housing developers, low-income housing advocates, lead-poisoning prevention advocates and experts, community-based organizations, physicians, scientists, and State, local and Federal agencies.

Efforts are under way now to explain the Task Force recommendations to housing industry groups and State and local governments and other organizations so that sensible, effective lead hazard

control policies can be incorporated into the normal operations of the housing industry and into State and local requirements. Also, the National Institute of Building Sciences is studying how Task Force recommendations may be incorporated into State or local housing codes. Finally, the American Society for Testing and Materials recently passed a consensus standard that incorporates many of the Task Force recommendations.

Lead Hazard Reduction in Federally Assisted Housing. On June 6, 1996, HUD published proposed regulations to implement sections 1012 and 1013 of Title X, which set forth specific policies on lead-based paint hazard reduction in federally assisted and federally owned housing. This proposed rule is a comprehensive amendment of current regulations and consolidates the many dispersed HUD lead-based paint requirements into one part of the Code of Federal Regulations. It also incorporates some of the recommendations of the Task Force report described above. Publication of the final rule is planned for the Fall of 1997.

Guidelines on Renovation and Remodeling. In April 1994, EPA published "Reducing Lead Hazards When Remodeling Your Home," an informative illustrated pamphlet designed to help home owners and contractors avoid exposure to lead dust and other lead-based paint hazards during renovation work. This widely distributed 24-page pamphlet was prepared in response to section 402(c)(1) of the Toxic Substances Control Act as amended by Title X. Home Depot and other hardware stores now distribute this information to their customers routinely.

Worker Protection. In May 1993, OSHA published interim final regulations on lead in the construction industry (29 CFR 1926.62). Contractors must assure that workers are protected from excessive exposure to lead. Those with high blood lead levels must be removed from exposure. The regulations also require employers to determine exposures so that adequate protective measures can be implemented.

Blood Lead Screening Programs

CDC administers the State and Community-Based Childhood Lead Poisoning Prevention Program, which provides grant funds for screening large numbers of young children for lead poisoning.

In addition, the Health Care Finance Administration of the Health and Human Services Department supports the Early and Periodic Screening, Diagnostic and Treatment (EPSDT) Program. This program provides comprehensive and preventive health care benefits to low-income children up to age 21 through State Medicaid programs. All Medicaid-eligible children aged six months to 72 months are considered at risk and must be screened for lead poisoning. The blood-lead test is part of the child's initial or periodic examination.

Conclusion

These accomplishments demonstrate that progress is being made in eliminating lead-based paint hazards in housing. Hazard control activities are being conducted in thousands of homes. Practical information is being provided to parents so they can protect their children. Improved technical information is being developed and disseminated on affordable, effective ways to control lead-based paint hazards. Normal maintenance and renovation activities are being modified to be lead-safe. The number of trained and certified professionals able to identify and control lead-based paint hazards is increasing, and improved rules for the protection of construction workers against lead poisoning are in place.

In a 1994 article in the *Journal of the American Medical Association* examining the decline in blood lead levels in the United States, James L. Pirkle and other authors from CDC concluded that "the major remaining sources are lead in paint and lead that has already accumulated in dust and soil." HUD, in cooperation with EPA, CDC and other agencies, is working to ensure that these exposures are controlled in order to eliminate childhood lead poisoning as a major disease.

Part 1: Implementation of Title X

In Title X of the Housing and Community Development Act of 1992 (Public Law 102-550), Congress authorized major changes in Federal law regarding the control of lead-based paint hazards and the reduction of lead exposure. This title, which is known as the Residential Lead-Based Paint Hazard Reduction Act of 1992, mandates coordinated action by several Federal agencies, including the Department of Housing and Urban Development (HUD), the Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), the Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health (NIOSH) and the General Accounting Office (GAO).

Four subtitles of Title X form the organizational structure of Part 1 of this report. Subtitle A is primarily the responsibility of HUD. Subtitle B amends the Toxic Substances Control Act and is primarily the responsibility of EPA. Subtitle C pertains to worker protection and is the responsibility of OSHA and NIOSH. Subtitle D calls for research by HUD and a report by GAO.

SUBTITLE A. LEAD-BASED PAINT HAZARD REDUCTION

The following discussion of progress in implementing Subtitle A is organized according to the sections found in this part of the Act.

Section 1011. Grants for Lead-Based Paint Hazard Reduction

This section of the Act authorizes a grant program for State and local governments for the evaluation and reduction of lead-based paint hazards in privately owned housing built before 1978 and occupied by low-income families. It is a continuation

of a similar program that was mandated by the HUD Appropriations Act for FY 1992.

From 1992 to 1995, HUD competitively awarded \$280 million to 56 local and State governments to control lead-based paint hazards in low-income privately-owned housing. About half of these funds (\$139 million) were awarded in 1995; one-third (\$94 million) in 1994; and the rest (\$47 million) in 1993. Over 30,000 housing units are to be treated with this funding. In October 1996, HUD announced an additional \$55 million in grants.

At the beginning of the grant program, local mechanisms were not in place in most parts of the country to identify and control lead-based paint hazards. Only one State (Massachusetts) had a comprehensive contractor certification program to ensure that the work would be done in a professional, safe and effective manner. Local housing and health agencies were not accustomed to working together, further delaying work. Finally, lack of insurance and qualified contractors contributed to delays.

As of this writing, 26 States have enacted enabling legislation for certification programs. This State activity results largely from the immediate incentive provided by the HUD grant program and from recently-released EPA regulations on worker and contractor certification.

All hazard reduction work funded under the program must be done by certified (licensed) contractors. This is required by the Appropriation Acts for FY 1992, FY 1993 and FY 1994. HUD requires that State grantees implement contractor certification programs before hazard evaluation and control work can be initiated under their grants. However, HUD has determined that city and county grantees should not

be penalized by the inaction of their States. Accordingly, since September 15, 1994 HUD has allowed local grantees in States without contractor certification programs to begin the hazard reduction process as long as they use contractors certified in other States with approved programs.

Section 1011(g) authorizes a related program of grants to States for the purpose of establishing State training, certification or accreditation programs. HUD and EPA have provided financial assistance to States in setting up certification programs. Beginning July 1, 1994, this assistance was consolidated in EPA.

In addition, EPA-sponsored training centers have trained approximately 6,000 inspectors and 4,400 abatement supervisors over the past several years. Private training providers have trained at least 25,000 personnel. Laboratory accreditation and proficiency testing programs are now established, with 395 laboratories participating as of November 1996.

Round One. In the first round of the Lead-Based Paint Hazard Reduction Grant Program (the round funded from FY 1992 appropriations and awarded in 1993), 65 applications were received and 10 grants were awarded totaling \$47.4 million. As of November 30, 1996, all grantees are engaged in hazard control activities, and over 64% of the funds have been expended. Table 2 provides a listing of Round One grantees.

Round Two. Nineteen grantees received \$93.5 million in Round Two (see Table 3). These grantees were selected after a thorough evaluation of 63 applications. The total amount awarded represents \$90 million from the FY 1993 appropriation, \$1.2 million from FY 1992, and the remainder from FY 1994 funds. The funds were awarded competitively to seven States, eight cities and four counties. As of November 30, 1996, all but four of the 19 grantees have reported initiating testing and hazard reduction activities.

Round Three. HUD announced the Round Three recipients on October 27, 1994 and made grant awards in early 1995. Thirty-five grantees received \$139.7 million, including 9 States, 24 cities and 2 counties. These grantees were selected after a thorough evaluation of 68 applications from 13 State governments, 42 cities, and 13 counties. As of November 30, 1996, 25 of the 35 Round Three grantees had begun testing and hazard control work. Table 4 lists the Round Three grantees.

Round Four. The grant competition scheduled to take place in FY 1995 was not conducted because of a budget rescission of \$85 million. In FY 1996, \$55 million was made available for the program. A total of 73 applications were received. Table 5 lists the Round Four grantees, which were announced in October 1996.

Table 2
Round 1 Grantees
(Data as of October 31, 1996)

Grantee	HUD Grant Award	Projected Units	Units Tested	Units Completed
ALAMEDA COUNTY, CA	\$ 4,410,296	180	216	112
BALTIMORE, MD	\$ 5,852,756	415	1,059	321
BOSTON, MA	\$ 3,656,360	305	177	97
CALIFORNIA	\$ 6,195,944	300	197	163
CLEVELAND, OH	\$ 3,884,341	200	85	35
MASSACHUSETTS	\$ 6,000,000	600	550	457
MINNESOTA	\$ 2,786,989	189	190	190
NEW JERSEY	\$ 4,250,000	226	49	0
RHODE ISLAND	\$ 4,070,528	145	160	101
WISCONSIN	\$ 6,341,220	455	484	348
TOTAL AWARDED	\$ 47,448,434	3015	3,167	1,824
TOTAL REQUESTED BY ALL APPLICANTS	\$ 231,200,000	—	—	—

Note: Grantees vary in terms of the amount of grant funds to be spent on activities other than hazard control (such as public education) and in the amount of local matching funds. Therefore it is not possible to accurately calculate the average cost per unit from this table.

Table 3
Round 2 Grantees (Data as of October 31, 1996)

Grantee	HUD Grant Award	Projected Units	Units Tested	Units Completed
Los Angeles County, CA	6,000,000	300	55	1
San Francisco, CA	6,000,000	2,775	353	226
New Haven, CT	3,000,000	250	153	0
Chicago, IL	6,930,559	625	673	14
Cambridge, MA	3,340,433	300	108	72
Springfield, MA	3,279,624	300	227	98
Maryland	6,000,000	600	403	0
Prince George's County, MD	3,649,569	550	187	1
Michigan	4,934,250	270	0	0
North Carolina	4,000,000	375	0	0
New York City	6,750,223	633	537	23
Cincinnati, OH	5,998,390	350	41	0
Ohio	5,792,913	540	67	16
Allegheny County, PA	3,427,830	700	34	0
Pennsylvania	3,800,000	340	0	0
Philadelphia, PA	6,000,000	391	146	105
Shelby County, TN	6,000,000	444	18	8
Virginia	5,433,926	1,500	0	0
Vermont	3,201,084	475	486	260
TOTAL AWARDED	\$ 93,538,801	11,718	3,488	824
TOTAL REQUESTED BY ALL APPLICANTS	\$259,800,000	—	—	—

Note: Grantees vary in terms of the amount of grant funds to be spent on activities other than hazard control (such as public education) and in the amount of local matching funds. Therefore it is not possible to accurately calculate the average cost per unit from this table.

Table 4
Round 3 Grantees
(Data as of October 31, 1996)

Grantee	HUD Grant Award	Projected Units
ARKANSAS	\$ 3,000,000	137
PHOENIX, AZ	\$ 4,500,000	315
ALAMEDA COUNTY, CA	\$ 5,996,861	490
CALIFORNIA	\$ 6,000,000	600
LONG BEACH, CA	\$ 5,999,986	1,100
MANCHESTER, CT	\$ 2,000,000	150
STAMFORD, CT	\$ 2,171,363	100
CONNECTICUT	\$ 6,000,000	700
GEORGIA	\$ 5,732,461	475
SAVANNAH, GA	\$ 3,142,606	340
ILLINOIS	\$ 5,999,943	500
KANKAKEE, IL	\$ 1,250,000	150
MASSACHUSETTS	\$ 4,642,330	1,450
BOSTON, MA	\$ 5,997,015	500
MALDEN, MA	\$ 4,000,000	350
BALTIMORE, MD	\$ 6,105,183	605
PORTLAND, ME	\$ 1,426,156	100
DETROIT, MI	\$ 5,917,839	350
ST. PAUL, MN	\$ 1,905,850	300
ST. LOUIS COUNTY, MO	\$ 1,239,870	200
NEW JERSEY	\$ 6,000,000	369
BUFFALO, NY	\$ 3,750,450	200
NEW YORK STATE	\$ 6,000,000	312
SYRACUSE, NY	\$ 2,696,483	225
MONTGOMERY COUNTY, OH	\$ 4,903,030	450

COLUMBUS, OH	\$ 4,687,684	288
TOLEDO, OH	\$ 1,500,000	220
CLEVELAND, OH	\$ 5,549,133	600
HARRISBURG, PA	\$ 1,200,000	80
RHODE ISLAND	\$ 6,000,000	469
MEMPHIS, TN	\$ 3,500,000	270
HOUSTON, TX	\$ 3,941,526	400
PETERSBURG, VA	\$ 2,000,000	500
RICHMOND, VA	\$ 3,267,169	1,052
NORFOLK, VA	\$ 1,653,118	200
TOTAL AWARDED	\$139,676,056	14,547
TOTAL REQUESTED BY ALL APPLICANTS	\$256,900,000	—

Note: Grantees vary in terms of the amount of grant funds to be spent on activities other than hazard control (such as public education) and in the amount of local matching funds. Therefore it is not possible to accurately calculate the average cost per unit from this table.

Note: As of June 1996, 179 units had been tested and 97 had been completed.

Table 5
Round 4 GRANTEES

Grantee	Announced Award
JEFFERSON COUNTY, AL	\$ 1,014,778
DUBUQUE, IA	\$ 3,690,619
SHREVEPORT, LA	\$ 1,142,300
CAMBRIDGE, MA	\$ 2,177,327
WAYNE COUNTY, MI	\$ 4,994,424
MINNEAPOLIS, MN	\$ 4,994,424
MINNESOTA	\$ 1,475,389
KANSAS CITY, MO	\$ 4,994,424
MISSOURI	\$ 1,997,894
CHAUTAUQUA COUNTY, NY	\$ 2,725,334
NEW YORK CITY, NY	\$ 1,596,274
CHARLOTTE, NC	\$ 4,986,800
MAHONING COUNTY, OH	\$ 4,295,668
SPRINGFIELD, OH	\$ 2,966,805
BOROUGH OF PALMERTON, PA	\$ 633,288
PHILADELPHIA, PA	\$ 1,573,200
VERMONT	\$ 1,804,610
RICHMOND, VA	\$ 1,368,818
MILWAUKEE, WI	\$ 4,994,424
WISCONSIN	\$ 1,573,200
TOTAL AWARDED	\$ 55,000,000
TOTAL REQUESTED BY ALL APPLICANTS	\$231,541,811

State Certification Grant Program. In 1992-1994, HUD was authorized to make grants of up to \$200,000 to States for the purpose of providing technical and financial assistance to establish training, certification and accreditation programs that meet the requirements of section 402 of the Toxic Substances Control Act. Recipients must have satisfactory enabling legislation. The grants are to be used to establish a lead-based paint contractor certification program. Awards have been made to 13 States: Arkansas, California, Connecticut, Louisiana, New Jersey, Maryland, Massachusetts, Missouri, Minnesota, Ohio, Rhode Island, Vermont, and Virginia. HUD has awarded a total of \$2,451,090 for these grants.

HUD accepted applications for the State Certification Program until June 30, 1994. States are now directed to apply to EPA under their State certification capacity-building program, announced in the Federal Register on March 3, 1994 under the authority of section 404(g) of the Toxic Substances Control Act. An announcement regarding this program consolidation action was published in the Federal Register on April 13, 1994. This action simplifies the program by consolidating all State capacity building efforts in EPA.

Section 1012. Evaluation and Reduction of Lead-Based Paint Hazards in Federally Assisted Housing

This section of the Act makes extensive amendments to the Lead-Based Paint Poisoning Prevention Act to establish explicit requirements for reducing lead hazards in federally assisted housing. Section 1012 also amends authorizing legislation for several Federal housing programs to make it explicit that evaluation and reduction of lead-based paint hazards are eligible activities under those programs.

HUD published proposed regulations implementing section 1012 on June 7, 1996 and expects to publish final regulations in the fall of 1997. These regulations will consolidate in the Code of Federal Regulations the many dispersed HUD lead-based paint regulations and make them consistent with

current scientific research and the recommendations of the Task Force on Lead-Based Paint Hazard Reduction and Financing (see Section 1015 below). There will be a single point of reference for all of the Department's lead-based paint requirements.

Because of the magnitude of the changes required in HUD's lead-based paint regulations and the impact these changes will have on other government agencies, the real estate industry, and the general public, HUD included outside organizations and individuals in the discussion of issues pertaining to the proposed Title X regulations. The discussions included: (1) the technical complexities of lead-based paint hazard evaluation and control, (2) coordination with other agencies and organizations charged with developing lead hazard control standards and procedures, and (3) the necessity of keeping the required procedures sensible and affordable. HUD has used the following avenues for outside consultation:

- HUD hosts quarterly meetings of the Federal Interagency Lead-Based Paint Task Force.
- HUD convened and participated in the Task Force on Lead-Based Paint Hazard Reduction and Financing, established under section 1015 of Title X (see Section 1015 below).
- HUD convened meetings with representatives of public housing authorities and related associations, Community Planning and Development (CPD) grantees, and housing industry representatives to gather input into the development of the proposed regulations. These meetings addressed Title X issues specific to housing and CPD programs.

Section 1013. Disposition of Federally Owned Housing

Section 1013 sets forth requirements for lead-based paint hazard reduction in residential units being sold by Federal agencies. It requires that all pre-1978 target housing be evaluated for lead-based paint and lead-based paint hazards prior to sale. For units built

between 1960 and 1978, the results must be made available to prospective buyers; for units built before 1960, any lead-based paint hazards must be abated. Implementation of these activities is subject to the availability of appropriations.

HUD published proposed regulations implementing section 1013 on June 7, 1996 in conjunction with regulations implementing section 1012. It is expected that final regulations will be published in the fall of 1997.

Section 1014. Comprehensive Housing Affordability Strategy

Under the Cranston-Gonzalez National Affordable Housing Act, State and local governments must develop a Comprehensive Housing Affordability Strategy (CHAS) as a prerequisite to receiving Federal housing or community development funds. Section 1014 requires that each CHAS include an estimate of the number of housing units that contain lead-based paint hazards and are occupied by low-income families. On-going and proposed remedies must also be included in the CHAS.

As a result of this initiative, many local communities now have much better estimates of the extent of lead hazards in local housing and a more systematic way of responding.

On March 12, 1993, HUD issued final rules for local governments and for States in the *Federal Register*. They became effective April 13, 1993. Instructions were issued on January 11, 1993, providing guidance for developing the Lead-Based Paint Element for the FY 1994 CHAS. They are

CPD Notice 93-02, for local governments, and
CPD Notice 93-03, for States.

HUD worked closely with the National Center for Lead-Safe Housing, which published *Lead-Based Paint Hazards and the Comprehensive Housing Affordability Strategy (CHAS)* in June 1993. It was widely distributed by the National Center to those preparing a CHAS and other interested parties.

During 1993, HUD provided training materials to those preparing a CHAS and a tabulation of the age of housing by income of residents for their city. The tabulation helped CHAS preparers estimate the number of housing units with lead-based paint hazards that are occupied by low-income and very low-income households.

In the course of reinventing HUD's Community Planning and Development (CPD) programs and simplifying and clarifying matters for applicants, consolidation of several programs and their requirements was completed in FY 1995. 24 CFR Part 91 was revised to promulgate the Consolidated Plan and Submission Document. The CHAS lead-based paint element was incorporated into the requirements of the Consolidated Plan.

Section 1015. Task Force on Lead-Based Paint Hazard Reduction and Financing

Section 1015 directs the Secretary of HUD, in consultation with the Administrator of EPA, to establish a Task Force comprised of Federal agencies and a broad range of non-governmental organizations. In response, the Task Force on Lead-Based Paint Hazard Reduction and Financing was created in October 1993 under the procedures of the Federal Advisory Committee Act. Chaired by Ms. Cushing Dolbeare, President of the National Low-Income Housing Coalition, the full Task Force and its three committees (Finance, Liability & Insurance, and Implementation) met on a regular basis during the eighteen months following its inception. Through an interagency agreement, HUD and EPA provided extensive staff support to the Task Force. *Putting the Pieces Together: Controlling Lead Hazards in the Nation's Housing*, the Final Report of the Task Force, recommends a number of actions, including:

- Benchmark standards for cost-effectively controlling lead hazards in private rental housing;
- Reforms in liability and insurance systems that encourage owners to take remedial actions;

- Education and public outreach initiatives;
- Expanded and more responsive private financing; and,
- Targeting public financing for hazard controls in poor urban neighborhoods.

HUD Secretary Henry Cisneros sent the Task Force report to each Member of Congress.

The Task Force full and summary reports are available from HUD User at 1-800-245-2691, the National Lead Information Center Clearinghouse at 1-800-424-LEAD, the U.S. Government Printing Office (GPO) at 202-512-1800, and the National Technical Information Service of the Department of Commerce at 1-800-553-6847. It is also available on HUD's world wide web site at www.hud.gov/lea/leahome.html.

Through a cooperative agreement with the Alliance to End Childhood Lead Poisoning, HUD is sponsoring a national education program based on the Task Force recommendations. The National Institute of Building Sciences (NIBS), under a grant from HUD, is investigating approaches to implement the recommendations of the Task Force on Lead-Based Paint Hazard Reduction and Financing concerning the inclusion of lead-based paint provisions in local health and housing codes.

Section 1016. National Consultation on Lead-Based Paint Hazard Reduction

This section of the Act calls for Federal interagency consultation on lead-based paint activities. Consultation is being achieved in several ways.

The Secretaries of HHS and HUD and the Administrator of EPA met on November 8, 1993, pursuant to the requirement in the Preventive Health Amendments of 1992 (P.L. 102-531) establishing an "Interagency Task Force on the Prevention of Lead Poisoning." The purpose of the Interagency Task Force is to review and coordinate departmental and

agency budget requests and ensure that priority activities receive appropriate attention.

Government-wide coordination is achieved through the Federal Interagency Lead-Based Paint Task Force, which has met regularly since April 1989. In addition to staff from EPA and HUD, the Task Force includes members from the following agencies:

- Centers for Disease Control and Prevention (CDC);
- Consumer Product Safety Commission (CPSC);
- Rural Housing and Community Housing Service (formerly Farmers Home Administration –FmHA);
- National Institute of Standards and Technology (NIST);
- Department of Defense (DoD);
- Department of Energy (DOE);
- Agency for Toxic Substances and Disease Registry (ATSDR);
- Food and Drug Administration (FDA);
- Health Resources and Services Administration (HRSA);
- National Institutes of Health (NIH);
- Occupational Safety and Health Administration (OSHA);
- Department of State;
- Department of Veterans Affairs (VA);
- Resolution Trust Corporation (RTC); and
- Indian Health Service.

Section 1017. Guidelines for Lead-Based Paint Hazard Evaluation and Reduction Activities

This section requires HUD to "issue guidelines for the conduct of federally supported work involving risk assessments, inspections, interim controls, and abatement of lead-based paint hazards." The guidelines are closely related to the regulations being prepared pursuant to sections 1012 and 1013. Section 1012(b) requires that the new requirements "be based upon guidelines developed pursuant to section 1017."

Guidelines have been prepared in consultation with EPA, CDC, VA, FmHA, NIST, DoD, and DOL. The

National Center for Lead-Safe Housing was responsible for most of the technical writing and has been assisted by several consultants and reviewers.

The HUD *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing* were released in August 1995. The document contains 18 chapters and several appendixes in a total of 745 pages. It is available from HUD USER at 1-800-245-2691, the National Technical Information Service of the Department of Commerce at 1-800-553-6847, and the U.S. Government Printing Office (GPO) at 202-512-1800. It can also be downloaded from HUD's world wide web site at www.hud.gov/lea/leahome.html. State and local governments, housing authorities, community development corporations and others routinely cite the *Guidelines* in their regulations, contract specifications, and work write-ups as the state-of-the-art in this highly innovative field.

Section 1018. Disclosure of Information Concerning Lead Upon Transfer of Residential Property

Before selling or leasing most pre-1978 housing, Section 1018 requires that sellers and lessors must:

- disclose all known information (e.g., inspection reports) on lead-based paint and lead-based paint hazards in the dwelling;
- provide to the purchaser or lessee the lead hazard information pamphlet (prepared by EPA, in consultation with HUD and CPSC pursuant to section 406 of the Toxic Substances Control Act); and
- include a specific Lead Warning Statement, with specific statutory language, in each contract to sell the residential property.

In addition, sellers must allow purchasers a ten-day opportunity to inspect the dwelling for lead-based paint hazards. Purchasers and sellers are free to

negotiate another mutually-agreeable time period and all other aspects of the inspection. Buyers are not required to get an inspection if they do not want one.

On October 26, 1994, HUD and EPA jointly announced proposed regulations, which were published in the Federal Register on November 2, 1994. Publication of the final rule occurred on March 6, 1996, with effective dates of September 6, 1996 for those who own more than four dwelling units and December 6, 1996 for those who own four or less units. The rule is expected to affect 9 million sales and leasing transactions annually. It is expected that the disclosure requirements will become a routine part of everyday housing transactions. The law helps to ensure that parents will get the information they need to protect their children.

HUD and EPA have worked to disseminate information about the rule very broadly. Together with the National Association of Realtors, HUD and EPA funded the distribution of 750,000 pamphlets to virtually every real estate agent in the country. The agencies have also issued interpretive guidance documents to answer a series of questions posed by those who are affected by the rule. A media strategy was also developed to ensure maximum outreach.

HUD is working with the Bureau of the Census to measure the impact of the disclosure rule by measuring the public's knowledge of lead-based paint hazards before and after it takes effect.

HUD has also funded the creation of a nationwide listing of lead-based paint inspectors, risk assessors and abatement contractors who are certified and trained to ensure that citizens could rapidly find qualified lead personnel. The listing was made available on HUD's world wide web site in October, 1996 and is also available through an automated phone system for those who cannot access the internet.

Subtitle B. Lead Exposure Reduction

Subtitle B of Title X amends the Toxic Substances Control Act (TSCA) by adding a new Title IV on Lead Exposure Reduction. This new Title directs EPA to develop regulations, guidelines, publications or studies on a large number of topics. Much of the Title pertains to public and commercial buildings as well as to housing. Information is also provided on three sections in Title IV that involve CDC, NIOSH and HUD as well as EPA. The section numbers used below are those of TSCA.

EPA Accomplishments

Section 402. Lead-Based Paint Activities Training and Certification

Subsection 402(a) requires EPA to establish a regulatory framework governing lead-based paint activities that will ensure that individuals engaged in risk assessments, inspections and abatement are properly trained, that contractors are certified (licensed), and that training programs are accredited.

EPA published proposed regulations in the *Federal Register* on September 2, 1994. On August 29, 1996, EPA published a final rule which contained the following requirements in target housing and child-occupied facilities:

- Training and certification to ensure the proficiency of contractors who offer to conduct lead-based paint inspection, risk assessments or abatement services in residences and day care centers;
- Accreditation requirements to ensure that training programs provide quality instruction;
- Work practice standards to ensure that lead-based paint activities are conducted safely, reliably, and effectively; and
- Procedures for States and Tribes to apply to EPA for authorization to administer these elements at the State or Tribal level.

For States and Tribes that choose to apply to EPA for authorization, the final rule also provides a model program that can be used to develop the State and Tribal program. In States and Tribes that do not apply for EPA authorization to administer a program, EPA will proceed to establish a program based on the federal program elements contained in the rule (see description of Section 404 below).

EPA has been developing a regulation to provide regulatory relief to contractors for the disposal of architectural components covered with lead-based paint. Currently, these wastes are covered by regulations implementing the Resource Conservation and Recovery Act and are required to be disposed of as hazardous waste if leachable lead is greater than 5 parts per million, as determined by the Toxicity Characteristic Leaching Procedure, an agency testing protocol used to determine if specific waste streams contain toxic levels of specific substances.

EPA realizes that the costs of hazardous waste disposal may be so great as to make the cost of lead-based paint hazard reduction efforts prohibitive. This regulation would allow less expensive disposal of architectural components, thus decreasing the costs of abatements without significant impact on the environment.

EPA has delayed the promulgation of training and certification requirements and work practice standards for individuals and firms conducting lead-based paint activities in public buildings (except child-occupied facilities), commercial buildings, superstructures and bridges. Based on public comment on the proposed rule, EPA decided that it needs additional time to examine options to establish requirements for individuals and firms that conduct deleading activities in public and commercial buildings, superstructures, and bridges. EPA also needs to examine options that will eliminate the potential for overlap between any training requirements and OSHA's training requirements for such individuals and firms.

A network of six university-based centers for training inspectors and abatement personnel has been established by EPA. These centers are linked to over

30 other universities, community colleges and other community-based training providers to ensure that training is readily available across the country. The courses are also offered by a large number of private training providers. Model curricula for courses in paint inspection, risk assessment, abatement supervision, and worker training have been completed. In 1997, all courses will be revised to reflect the promulgation of the 402 requirements.

Subsection 402(c)(1) requires EPA to prepare guidelines for conducting renovation and remodeling (R&R) activities to reduce the exposure to lead in connection with the R&R activities.

EPA published the guidelines entitled: "Reducing Lead Hazards When Remodeling Your Home," (EPA-747-R-94-002) in April 1994. The document was published in both English and Spanish and disseminated to hardware stores, renovation and remodeling trade groups, federal, state and local governments and homeowners. Home Depot, the national hardware chain store, reproduced the document in a one-page form and placed complimentary copies in all of their stores nationwide. Copies of the Guidelines are available through the National Lead Information Center Clearinghouse.

Subsection 402(c)(2) requires that EPA conduct a study to determine the extent to which persons engaged in various types of renovation and remodeling activities create a lead-based paint exposure hazard for workers, themselves, or occupants where the work is being conducted.

The renovation and remodeling study is being conducted in four phases.

- Phase 1, now completed, is called the Environmental Field Sampling Study and measured levels of lead in workers' breathing zones and in settled dust generated by various renovation and remodeling work activities (e.g., window replacement, carpet removal, demolition of building components, etc.). The study demonstrated that some work activities can result in worker exposure which exceeds the

OSHA permissible exposure limit. A final report is expected to be published by winter 1997.

- Phase 2, also completed, is called the Worker Characterization and Blood-Lead Study. It involved the collection of blood-lead samples and questionnaire information from 581 renovation and remodeling professionals in two large metropolitan areas to focus on the relationship between workers' blood-lead levels and their work activities. The results show that the distribution of blood-lead levels among the sample of 581 renovation and remodeling professionals was not significantly greater than the general population. In general, there was no indication that any group of renovation and remodeling workers was seriously exposing themselves to lead during their work. A final report is expected to be published by winter 1997.
- Phase 3, which will have data collection completed by winter 1997, is called the renovation and remodeling Wisconsin Kid's Study. Phase 3 is a retrospective study using Wisconsin's extensive registry of children's blood-lead data. A total of 3600 telephone interviews will be completed with parents/guardians of children whose blood-lead is already known. Each interview will collect information about residential renovation and remodeling work conducted prior to the child's blood-lead measurement. The objective of this study is to explore the potential relationship between residential renovation and remodeling work and elevated blood-lead levels in children.
- Phase 4 of the renovation and remodeling study will be an extension of Phase 2. Renovation and remodeling professionals who spend a considerable amount of their work time in old or historic houses will be carefully observed. The results of Phase 2 suggest that, in general, renovation and remodeling workers are not exposing themselves to lead during the conduct of their work. Phase 4 will focus on those renovation and remodeling professionals who are thought to be most highly exposed (using

blood-lead measurements). This study will be completed by fall 1997.

Other information on the hazards of renovation and remodeling work can be found in Shannon 1992 and Rabinowitz 1985. Both of these studies correlated renovation work with elevated blood lead levels in hundreds of young children.

Subsection 402(c)(3) requires EPA to revise the regulations issued under subsection 402(a) to apply to renovation and remodeling activities using the study conducted under subsection 402(c)(2). If EPA determines that any category of renovation and remodeling contractors does not require certification, the agency must publish an explanation of the determination.

After the study under subsection 402(c)(2) has been completed, EPA will consider whether regulatory revision is necessary.

Section 403. Identification of Hazardous Levels of Lead

Section 403 requires EPA to develop standards for identifying lead-based paint hazards, lead-contaminated household dust, and lead-contaminated residential soil. The direct effect of this regulation will be to provide standards for use in other regulations that have been developed or are being developed under the statute, including: hazard evaluation and control in federally assisted and owned housing (Sections 1012 and 1013); real estate disclosure (Section 1018); and training, certification, accreditation, and work practice standards (Section 402).

EPA issued guidance for identifying lead hazards in July 1994, which was published in the *Federal Register* in September 1995. This document will serve as interim guidance until EPA promulgates regulations under section 403.

The section 403 rulemaking effort consists of two closely coordinated activities. The first activity is the development of a comprehensive risk assessment that will document the scientific basis in the

methodology used to characterize baseline health risks to young children from exposures to lead, estimate the reduction in childhood health risks expected to result from various options for standards, and estimate the number of homes and children that would be affected. Input will also be provided to the economic analysis and regulatory impact analysis and will support EPA's risk management decisions. The second activity is the identification of regulatory issues and the development and analysis of options to address these issues.

The comprehensive risk assessment includes a hazard assessment, exposure assessment, dose-response analysis, and an integrated analysis that incorporates the separate assessments. The analysis is based on two tools, the Integrated Exposure Uptake Biokinetics Model and an empirical model developed using data from a recent HUD study that was conducted in Rochester, NY. Both tools will be applied to the HUD National Survey, the only nationally representative data set that contains data on lead in residential paint, dust, and soil. EPA plans to submit the risk assessment for a limited peer review in early 1997 and to the Agency's Science Advisory Board during the public comment period for the proposed rule.

Concurrent with the development of the risk assessment, EPA has been identifying and analyzing regulatory and policy issues. Examples include the approach to standard setting and the basis for the standards. For each issue, EPA has developed and analyzed several options. To assist in the process of identifying issues and developing options and to seek stakeholder input early on in the rule development process, EPA established a Dialogue Process, which met four times in late 1995 and early 1996. Participants, who represented advocates, property owners, the banking and insurance industries, the lead manufacturing industry, the lead paint abatement industry, and state and local governments, provided valuable insights and feedback to the Agency. In several instances, participants identified issues and proposed options that EPA had not previously considered.

Following peer review of the risk assessment, regulatory options will be presented to EPA senior management for a final decision. These decisions will be incorporated into the proposed rule which EPA expects to publish in 1997.

Section 404. Authorized State Programs

Section 404 mandates a process under which EPA will approve State programs for training and certification of lead-based paint contractors under section 402 and for performing the requirements of section 406. **Subsection 404(d)** requires EPA to promulgate a model State program that may be used by States seeking to administer programs under this Title. The State program must be at least as protective as the Federal program and must provide adequate enforcement. In those States lacking their own programs, EPA must establish, administer, and enforce Federal programs.

EPA published proposed regulations for the approval process and the Model State Plan on September 2, 1994. The final rule was promulgated on August 29, 1996 (see description of Section 402(a) above).

Subsection 404(g) authorizes EPA to make grants to States to develop and carry out programs authorized under section 404.

EPA has awarded \$36.2 million to 46 States and 27 Tribes in fiscal years 1994, 1995, and 1996. An additional \$12.5 million will be awarded in FY 1997. A similar HUD program has been combined with this EPA program.

Section 405. Lead Abatement and Measurement

Subsection 405(a) requires EPA and other appropriate agencies to conduct a comprehensive program to promote safe, effective, and affordable monitoring, detection and abatement of lead-based paint and other lead exposure hazards.

EPA is working with the States of Maryland and Wisconsin to evaluate lower cost methods for abating lead exposure hazards.

In Maryland, “repair and maintenance” and full scale abatement are being evaluated using less costly and potentially more cost-effective housing interventions designed to reduce children’s exposure to lead in residential paint and dust. It is expected that results of the 12 months and 24 months post-intervention findings of this study will be available in spring and fall 1997, respectively. In Wisconsin, lower cost abatements, including those focusing on windows, are being evaluated.

The effectiveness of in-home education of families while abatement arrangements are being made is also being evaluated. EPA has also completed a study of comprehensively abated housing units in Denver. The final reports for the study are: “Comprehensive Abatement Performance Study, Volume I: Summary Report,” April 1996, EPA 230-R-94-013a and “Comprehensive Abatement Performance Study, Volume II,” April 1996, EPA 230-R-94-013b.

EPA has completed a laboratory study of lead cleaning efficacy of general household cleaners, including trisodium phosphate (TSP) that could be used to remove lead-containing dust from residential surfaces. It is expected that the report of this study will be available in spring 1997.

EPA completed a Compositing Wipe Study which examined the feasibility of analyzing composites of wipes (where two to four wipes are collected and combined for analysis, thereby reducing both sampling and analysis costs) compared to single wipes. This study showed that compositing is feasible and less expensive than single-surface samples. The final report was published in July 1996, “Analysis of Composite Wipe Samples for Lead Content,” EPA 747-R-96-003.

In 1995, HUD and EPA completed a study on lead-based paint technologies (X-ray fluorescence (XRF) and home test kits). The study concluded that testing by K-shell XRF instruments, with laboratory confirmation of inconclusive XRF results, and with substrate correction in cases where this is effective in reducing bias, is a viable way to test for lead-based paint. This approach can produce satisfactory results

for classifying the paint on architectural components using the federal threshold of 1.0 mg/cm².

The study also concluded that test kits evaluated in the study should not be used for lead paint testing. Test kits cannot determine the extent of lead-based paint in a home and the need for protecting the occupants, especially when repairs or renovations are carried out. Homeowners and renters cannot be confident that test kits will discriminate accurately between lead-based paint and non-lead-based paint. The final report, "A Field Test of Lead-Based Paint Testing Technologies: Technical Report," EPA 747-R-95-002b, was published in May 1995.

EPA published the results of a laboratory study of dust and dust lead recoveries for samplers and vacuum cleaners in two volumes. Two standardized laboratory testing procedures were developed in this study. The first was designed to characterize the performance of three vacuum sampling and one wipe sampling method. All of these sampling methods have been used in previous EPA studies. The second was designed to evaluate how well commercially-available vacuum cleaners collect dust from various surface types. The final reports are: "Laboratory Evaluation of Dust and Dust Lead Recoveries for Samplers and Vacuum Cleaners, Volume I: Objectives, Methods, Results," (March 1995, EPA 747-R-94-004A), and "Laboratory Evaluation of Dust and Dust Lead Recoveries for Samplers and Vacuum Cleaners, Volume II: Appendices from the Quality Assurance Project Plan," (March 1995, EPA 747-R-94-004B).

EPA completed many additional analyses and field studies to support Section 405(a). The following technical reports were published as a result of the studies:

"Lead-Based Paint Abatement and Repair and Maintenance Study in Baltimore: Pre-Intervention Findings," (August 1996, EPA 747-R-95-012).

"Report on the National Survey of Lead-Based Paint in Housing, Base Report," (April 1995, EPA 747-R-95-003)

"Report of the National Survey of Lead-Based Paint in Housing, Appendix I: Design and Methodology," (April 1995, EPA 747-R-95-004)

"Report of the National Survey of Lead-Based Paint in Housing, Appendix II: Analysis," (April 1995, EPA 747-R-95-005)

"Seasonal Rhythms of Blood-Lead Levels: Boston, 1979-1983," (September 1995, EPA 747-R-94-003)

"Seasonal Rhythms of Blood-Lead Levels in Milwaukee," (August 1996, EPA 747-R-95-010)

"Residential Sampling for Lead: Protocols for Dust and Soil Sampling," (March 1995, EPA 747-R-95-001)

"Sampling House Dust for Lead: Basic Concepts and Literature Review," (September 1995, EPA 747-R-95-007)

"Pilot Testing Program for Protocols for Lead-Based Paint Encapsulants," (September 1995, EPA 747-R-95-011)

"Comprehensive Abatement Performance Pilot Study, Volume I: Results of Lead Data Analysis," (February 1995, EPA 747-R-93-007)

"Review of Studies Addressing Lead Abatement Effectiveness," (July 1995, EPA 747-R-95-006)

"Effect of In-Home Educational Intervention on Children's Blood Lead Levels in Milwaukee," (April 1996, EPA 747-R-95-009)

Subsection 405(b) requires EPA to establish protocols, criteria, and minimum performance standards for laboratory analysis of lead in paint films, soil, and dust. The subsection also requires EPA to establish a program to certify laboratories or to determine that effective voluntary accreditation programs are in place.

In response to this section, EPA has established the National Lead Laboratory Accreditation Program

(NLLAP). NLLAP recognizes laboratories which have demonstrated the ability to accurately analyze lead in paint, dust, and soil samples.

In order for laboratories to be NLLAP recognized they must successfully participate in the Environmental Lead Proficiency Analytical Testing (ELPAT) Program and undergo a systems audit performed by an NLLAP laboratory accrediting organization.

The American Association for Laboratory Accreditation (A2LA), and the American Industrial Hygiene Association (AIHA) are NLLAP laboratory accrediting organizations. Since December of 1993 more than 100 laboratories have obtained NLLAP recognition. Currently, more than 300 laboratories are participating in the ELPAT Program. The National Lead Information Clearinghouse (described in the next paragraph) provides the public with a monthly updated list of NLLAP recognized laboratories.

Subsections 405(d) and (e) require EPA, in conjunction with HHS, ATSDR, and HUD, to sponsor public education and outreach activities to increase public awareness of lead poisoning.

Public education and outreach activities include the National Lead Information Center Clearinghouse and Hotline. The Hotline was established in November 1992, and the Clearinghouse was established in April, 1993. These services are sponsored by EPA, with assistance from HUD, CDC and DoD. The Hotline phone number is 1-800-LEAD-FYI. Recorded messages are available 24 hours per day. Callers receive a free information packet, including four lead paint fact sheets, a list of State and local lead contacts, and a pamphlet entitled "Lead Poisoning and Your Children." These materials are also available in Spanish. Callers to the Hotline with specific questions are referred to the Clearinghouse and can speak directly with an information specialist.

The Clearinghouse phone number is 1-800-424-LEAD. Service is available Monday through Friday, 8:30 A.M. to 5:00 P.M. EST. Callers are provided with relevant informational materials, including

Federal publications, selected journal articles, and updates of Federal laws and regulations. Callers may also obtain information on qualified laboratories; referrals to Federal, State, and local agencies; EPA regional lead training centers (RLTC's); and EPA regional lead contacts as well as printed materials from other Federal agencies.

Since the fall of 1996, coinciding with the first effective date of the Section 1018 disclosure and notification rule, the Clearinghouse has been averaging approximately 20,000 calls per month.

The National Lead Information Center internet address is: <http://www.nsc.org/ehc/lead.htm>

A study of lead education was conducted by EPA in cooperation with the Milwaukee Health Department ("Effect of In-home Educational Intervention on Children's Blood Lead Levels in Milwaukee") was distributed to health departments around the country and made available through the Clearinghouse and world wide web.

In 1994, the National Safety Council conducted a Public Service Announcement (PSA) campaign, which included print advertisements and television and radio spots. Its purpose was to raise awareness and motivate audiences to obtain further information by calling the Hotline number. PSA's were distributed to approximately fifty of the nation's largest media markets with potential lead exposure problems. Additional national public service announcements are being planned.

Subsection 405(f) requires the President to establish criteria, testing protocols and performance characteristics to ensure that products intended for lead-based paint hazard evaluation and reduction are effective.

HUD, NIST and EPA are developing a procedure for responding to this requirement. The American Society for Testing and Materials (ASTM) has produced over 20 consensus technical standards on sampling and analytical techniques, testing procedures, and hazard control practices.

EPA has completed a strategy document for 405(f). This document will have two functions: 1) Program Option Selection: Various options for program implementation are presented and discussed; 2) Existing Standards and Protocols: A knowledge base of existing performance standards and test protocols by product category have been gathered together. It is anticipated that these will be used to jump start the program once an implementation option has been selected.

One product area, lead-based paint encapsulants, has been a leader in responding to section 405(f). ASTM Task Group E06.23.30 initiated consensus building discussions on the development of performance standards for the testing of lead-based paint encapsulant products in the early 1990's. However, there was little if any data available to serve as the technical basis for these standards. Recognizing the critical need for data, EPA and HUD decided to begin evaluating existing tests for encapsulation products. EPA, with funding from HUD, carried out a laboratory study of thirteen protocols for testing encapsulant products. The study generated approximately 3800 new data on testing protocols. Overall, most of the protocols were found to be feasible for most of the encapsulant products tested. A final report was published in September 1995. The information from the EPA Study was conveyed to the ASTM Task Group, and subsequently the Task Group published two ASTM standard specifications for testing encapsulant products.

Section 406. Lead Hazard Information Pamphlet

Subsection 406(a) requires EPA to publish, after notice and comment, a lead hazard brochure to be used in conjunction with requirements under sections 1018 and 406(b).

EPA developed a draft pamphlet and announced its availability for comment in the *Federal Register* on March 9, 1994. Subsequently, EPA conducted several focus group tests and an additional public meeting. EPA announced the availability of the final pamphlet in the *Federal Register* on August 1, 1995. In addition, EPA has developed a Spanish language

version of the pamphlet. Single copies of the pamphlet are available from the National Lead Information Clearinghouse. Multiple copies are available through the Government Printing Office. EPA also makes the pamphlet available in alternate versions, including color negatives and black and white camera ready copy through its regional offices. **Subsection 406(b)** requires EPA to promulgate regulations to require renovators, prior to beginning work, to provide their customers with the pamphlet developed under section 406(a) describing lead hazards and how they can be minimized.

EPA published the proposed rule in the *Federal Register* on March 9, 1994 and expects to publish the final rule in 1997.

Additional EPA projects related to Title X.

The following projects, while not mandated specifically by Title X, relate to its purpose—the need to control exposure to lead-based paint hazards.

EPA Lead Environmental Justice Initiative

The goals of the “Community-Based Lead Abatement Demonstration Project” are to: **1)** demonstrate that an effective, well-planned program can serve to significantly reduce poor children’s blood lead levels, **2)** demonstrate the utility and beneficial nature of public, private, and community cooperation in the prevention of childhood lead poisoning, **3)** accomplish specific primary and secondary lead poisoning prevention tasks: blood lead screening, hazard reduction, and education, **4)** assess and document the project’s success and shortcomings by providing for careful evaluation and data collection, and **5)** foster self-sufficiency through jobs creation and empowerment.

If fully successful, the initiative will result in: reduced lead poisoning in the target population of poor children; a proven, reproducible program to reduce blood leads; and feedback on how to improve individual programs and how programs can be better coordinated.

In 1993, EPA formed an inter-agency workgroup consisting of: the Department of Housing and Urban Development; the Administration for Children and Families (Department of Health and Human Services); the Centers for Disease Control (Department of Health and Human Services); and the Department of Labor. EPA also acted to enlist the assistance of the Philadelphia Health Department and community advocates. EPA and the Administration for Children and Families committed \$3.7 million dollars for the support of pilots that would test the prototypical, community-based approach formulated by the participants for preventing childhood lead poisoning.

Philadelphia received a non-competitive grant in 1994. A competitive grant program was formulated over the course of the same year. In 1995, a joint EPA-ACF Notice of Funds Availability announcing the program was published in the Federal Register. In September 1995, grants were awarded to five local government-community advocacy group partnerships in: Chicago, Illinois; Milwaukee, Wisconsin; Missoula, Montana; Memphis, Tennessee; Oakland, California.

EPA Whole House Initiative

The goals of the “Multimedia ‘Whole House’ Environmental Justice Initiative” are to:

- enable parties to reduce multimedia exposures to unhealthful levels of pollution both inside and

outside the home in disenfranchised and disadvantaged communities;

- ensure that mitigation of hazardous exposure in the home is comprehensive and addresses lead, asbestos, weatherization (i.e., window replacement etc.), indoor air quality and radon exposure issues;
- build capacity and economic opportunities in targeted communities through creating or strengthening an infrastructure that provides community access to State agencies responsible for reducing environmental exposures;
- and demonstrate how the federal government and their State/local counterparts can provide a comprehensive and coordinated response to potential hazards in targeted communities.

In 1994, EPA formed an inter-Office/Agency workgroup consisting of: the Department of Housing and Urban Development; the Administration for Children and Families (Department of Health and Human Services); the Centers for Disease Control (Department of Health and Human Services); the Department of Energy; and the Offices of Small and Disadvantaged Business Utilization, Air and Radiation; and Enforcement and Compliance Assurance. This workgroup cooperated in the planning of an effort to apply a multimedia, Geographic Information Systems (GIS) database and create an integrated, multimedia environmental inspection training. In 1995, a grant was awarded to Cleveland to field-test both the data and training.

Centers For Disease Control and Prevention Accomplishments

Subsection 405(c) directs HHS, through CDC, to study sources of lead exposure in children who have elevated blood-lead levels. It also requires NIOSH to study the means to reduce hazardous occupational lead abatement exposures. Activities by CDC and NIOSH, and relevant studies by EPA and HUD, are discussed below.

The CDC State and Community-Based Childhood Lead Poisoning Prevention Program provides grant funds for the initiation and expansion of State programs and community-based childhood lead-poisoning prevention programs that:

- screen young children for lead poisoning;
- identify possible sources of lead exposure;
- monitor medical and environmental management of identified children who have been poisoned;
- provide information to the public, health professionals and policy makers; and
- encourage community action programs to eliminate childhood lead-poisoning.

Grant funds may also be used to develop the infrastructure needed to ensure timely and effective screening of children and identification and remediation of environmental lead hazards.

HUD and CDC are funding primary prevention projects in Chicago and Rhode Island that use existing community groups to implement lead poisoning prevention activities in a locally-driven strategy. Results of these projects will become available in early 1988.

The Conference of State and Territorial Epidemiologists (CSTE) conducted a survey to determine the extent and nature of surveillance activities for elevated blood lead levels throughout the United States. Over fifty percent of States have laws or regulations requiring reporting of elevated blood-lead levels among children. In May 1995, CSTE added elevated blood-lead levels to the National Public Health Surveillance System.

The Health Care Finance Administration (HFCA) supports the Early and Periodic Screening, Diagnostic and Treatment (EPSDT) Program. This program provides comprehensive and preventive health care benefits to low-income children up to age 21 through State Medicaid programs. All Medicaid-eligible children aged six months to 72 months are considered at risk and must be screened for lead poisoning. The blood-lead test is part of the child's initial or periodic EPSDT examination. Currently, an effort to boost the overall EPSDT screening rate is underway.

CDC and the State of Massachusetts are collaborating to develop a model information system to link and integrate multiple data-bases providing information on health, housing, and the environment to facilitate medical and environmental management of children identified with elevated blood lead levels (EBLs).

Screening data from the Chicago Department of Health laboratory has been analyzed to determine trends in children's blood-lead levels and the effect of reductions in leaded gasoline over time. A report was published in *Pediatrics* in February 1994, which is discussed in more detail in Part 2 of this report.

The CDC NHANES III project collected data regarding health indicators and environmental exposure on 30,000 persons over a period of six years. These data allow evaluation of the extent of exposure to lead in the United States. The data also identify correlates of exposure, such as urbanization, region, socioeconomic status, age of housing and physical characteristics. Results of Phase I of the survey were published in the *Journal of the American Medical Association (JAMA)* in July 1994 and are discussed in detail in Part 2 of this report (Pirkle 1994, Brophy 1994). Results of Phase 2 were published in *Morbidity and Mortality Weekly Report* on February 21, 1997.

The Injury Control and Risk Survey (ICARIS) obtained indicators of health, injury, and exposure to environmental substances. Information was collected from a nationally representative sample of U.S.

households. Respondents were asked whether children have been screened for lead poisoning and the paint has been analyzed for lead content.

CDC has numerous on-going studies to identify sources of lead exposure including:

- The Mahoning County Health Department Study, under subcontract with the Ohio State Health Department and using funding from the CDC State and Community-Based Childhood Lead Poisoning Prevention Program grant, examines the risk of elevated blood lead levels among children 12-15 months old who live in housing of different ages. Data collection is completed and report preparation is in progress.
- The Montefiore Medical Center Study is studying risk factors among children at the Center's satellite primary care centers who have elevated blood lead levels. The New York Health Department, in collaboration with Montefiore and CDC, is conducting this study (data collection in progress).
- The FBI Firing Range Study evaluates the risk of lead exposure incurred by members of households in which at least one person worked at an FBI firing range (data collection completed, report in progress).
- The Isotope Analysis Study examines whether the analysis of isotope ratios of lead in blood and environmental samples provides a means by which to differentiate between various sources of environmental lead and to link sources of lead in the environment with lead in children's blood (report to be completed).
- The Source Apportionment of Lead in Household Dust Study analyzes various sources that contribute to lead accumulation in house dust of urban dwellings by measuring stable lead-isotope ratios and multi-element "fingerprints" (now under-going lab analysis).

- Other recent reports that have been completed on less common sources of lead exposure, such as water, inadequately fired pottery, and folk remedies include "Lead Contaminated Drinking Water in Bulk-Water Storage Tanks—Arizona and California" (1994) and "Lead Poisoning Associated with Use of Traditional Ethnic Remedies" (1993).

National Institute for Occupational Health and Safety Accomplishments

The ongoing NIOSH Adult Blood Lead Epidemiology and Surveillance (ABLES) program monitors elevated blood lead levels (blood lead levels greater than or equal to 25 µg/dL) of adults in 25 States (CDC 1996). These data come from laboratory reports that are transmitted to State-based lead surveillance programs. In 1995, ABLES programs in 16 of the 25 states were supported by NIOSH Cooperative Agreements. Current information about ABLES state activities is available on the internet at <http://www.cdc.gov/niosh/ables.html>.

NIOSH publishes the ABLES surveillance data on a quarterly basis. The results show that although occupational lead exposures continue to be a significant public health problem in the United States, there is some improvement. For example, with a constant 23 states reporting, the number of persons with elevated blood lead levels for 1995 increased by 4 percent over 1994, but the number of new cases among them decreased by 11 percent. These differences could also be explained by different reporting patterns among the states and inter-state differences in worker blood lead testing by lead-using industries.

Extrapolating on the basis of population, it is estimated that reports for 19,700 adults with elevated blood lead levels would have been received by NIOSH in 1995 if all states participated fully. Data from NHANES III (Phase 1, 1988-1991) indicate that as many as 700,000 adults (20-74 years of age) have elevated blood lead levels greater than or equal to 25 µg/dL. The large disparity between this estimate and the numbers from the ABLES database

may be due to unreported occupational lead exposures. Occupational exposure is the main source of adult lead exposure. NIOSH and state surveys have indicated that employer medical monitoring programs for lead exposure are commonly inadequate in the construction industry.

TSCA Subsection 405(c)(2) requires NIOSH to study ways to reduce hazardous occupational lead abatement exposures. The following NIOSH studies and activities are related to the implementation of this subsection:

- Evaluation of occupational lead exposures during repainting of an elevated water storage tank which was coated with lead-based paint in Maryland, completed in 1991.
- Evaluation of occupational lead exposures in a building painted with lead-based paint and used as a child-care facility in Cincinnati, Ohio, completed in FY 1992.
- Publication of a NIOSH Alert requesting assistance in preventing lead poisoning in construction workers, completed FY 1992.
- Evaluation of worker exposures and effectiveness of building cleanup during a lead-based paint abatement pilot project at Ohio University, Athens, Ohio, completed in FY 1993.
- A field study of the effect of State of Connecticut health and safety contract specifications on lead exposures among Connecticut bridge workers engaged in lead-based paint removal on steel structures including airborne and blood-lead measurements. Contract report by the State of Connecticut Health Department completed December 1994.
- A field study to measure construction workers' lead exposures and lead contamination of their automobiles during a highway bridge renovation project. Health hazard evaluation report completed April 1995 (Report no. HETA 93-0502-2503).
- A field study of lead exposures among residential home painters conducted in Washington State. The study found that home painters were potentially overexposed to lead, and lead hazards for occupants were created during surface preparation activities in pre-1950 homes. Contract report completed in 1995.
- Evaluation of lead exposures during home renovation and repair activities in pre-1960 single-family homes in Cincinnati, Ohio.
- Development of a comprehensive research report to Congress entitled *Protecting Workers Exposed to Lead-Based Paint Hazards: A NIOSH Report to Congress* in response to Title IV.
- A field study in California to design, implement, and evaluate a lead poisoning intervention strategy among residential painting contractors and workers. Generally inadequate health and safety programs were found among residential and commercial painting contractors before intervention activities. In 1996 this project produced the *Painting Contractor's Guide to Lead Safety*.
- Development and evaluation of field measurement techniques for lead in paint. A collaborative test of ultrasonic extraction with field portable anodic stripping voltammetry (ASV) analysis of lead in paint chips, soils, dusts and air will be undertaken by NIOSH in cooperation with ASTM. The study will involve the analysis of samples by at least 12 cooperating laboratories. Ongoing in FY 1997.
- Proficiency testing and laboratory accreditation programs to ensure the quality of lead-based paint analyses currently cover quantitative lead analyses in paint, soil, and dust performed at fixed laboratory locations and in self-contained mobile laboratories. Programs are being expanded to cover portable quantitative lead analyses conducted in the field.
- Development of an updated NIOSH Criteria Document for a Recommended Standard:

Occupational Exposure to Inorganic Lead. Ongoing in FY 1997.

- An evaluation of the effectiveness of lead abatement certification training programs conducted in Illinois, using the EPA Model Training and Curriculum for workers and supervisors. Completed FY 1995.
- Funding of the Connecticut Road Industry Surveillance Project (CRISP), an innovative program to reduce lead exposure in bridge workers through the incorporation of protective measures into construction contracts.
- A field study of occupational lead exposures during residential lead hazard control activities, including those at HUD-funded sites. Surveys to measure airborne and surface lead concentrations were conducted in California and Rhode Island during 1995-96. A summary report which includes recommendations for appropriate worker protection will be prepared in 1997.
- A study to evaluate the immunologic effects of lead exposure among secondary lead smelter workers, in collaboration with the National Institute of Environmental Health Sciences. Although some subtle differences were found between lead-exposed and unexposed workers, the study findings offered reassurance that lead exposure as permitted under the current OSHA lead standard does not have marked immunologic effects.
- A collaborative study with the New Jersey Department of Health to assess para-occupational (take-home) lead exposures among children of construction workers. The study included blood lead level measurements and lead-exposure assessments of workers' families and a control population. Epidemiological and industrial hygiene findings are scheduled for journal publication in 1997.
- A cooperative agreement was begun in September 29, 1995, between NIOSH and the Washington State Department of Labor and Industries. It is entitled, "An Intervention to Prevent Occupational Lead Over-Exposure in King County, Washington," and seeks to develop a model for the elimination of lead poisoning by integrating case surveillance, hazard surveillance and technical assistance within a geographic area. Ongoing in FY 1997.
- A cooperative agreement was begun on September 29, 1995, between NIOSH and the Iowa Department of Public Health, entitled, "Iowa Intervention Project to prevent Adult Lead Poisoning." It seeks to test the efficacy of the recommendations to reduce blood lead levels which were made to adults found to have elevated blood lead levels. Ongoing in FY 1997.
- A cooperative agreement ("Lead Poisoning Prevention with States in Collaboration with Local Health Departments, Illinois Department of Health") developed an intervention methodology and evaluation strategy for preventing excessive exposures to lead in small businesses. Indoor firing ranges were chosen to test the efficacy of two intervention strategies, one consisting of education alone and one consisting of education plus recommendations for substitution for hazardous material and/or ventilation. To be completed in FY97.

Subtitle C. Worker Protection

Subtitle C pertains to worker protection and is the responsibility of the Department of Labor Occupational Safety and Health Administration (OSHA) and the National Institute of Occupational Safety and Health (NIOSH).

Section 1031. Worker Protection

Title X requires the Secretary of Labor to issue interim final regulations on occupational exposures to lead in the construction industry by April 1993. OSHA's construction regulations must be at least as protective as HUD's "Interim Guidelines for Public Housing." The interim final rule was published in the *Federal Register* on May 4, 1993 as 29 CFR 1926.62.

Contractors are required to conduct an exposure assessment for each job classification in each work area where there is potential exposure to lead. If exposures are above the permissible limit, they must be controlled. Employers must develop a written compliance plan, designate a competent person to oversee worker protection efforts, and conduct medical surveillance. Workers with high levels of lead in their blood must be removed from further exposure.

Section 1032. Coordination Between Environmental Protection Agency and Department of Labor

Close coordination is mandated between EPA and OSHA, for OSHA worker protection requirements are an integral element of training and certification programs. This coordination has been accomplished by two methods: (1) an

ongoing committee that meets approximately once per month, which is known as the ONE Committee (for OSHA, NIOSH and EPA); and (2) detailed consultation with OSHA in the development of the training requirements that are part of the regulations developed pursuant to sections 402 and 404.

The purpose of the ONE Committee is to coordinate regulatory and enforcement actions of the three agencies, including worker protection mandated in section 1031.

Section 1033. NIOSH Responsibilities

Subsection 1033(a) authorizes a minimum of \$10 million per year to the National Institute for Occupational Safety and Health (NIOSH) for a lead-based paint worker and supervisor training grant program and \$500,000 per year for the periodic and comprehensive assessments of the program.

NIOSH and EPA have awarded grants for training workers and supervisors in lead-based paint activities. Their review panels work together but the two agencies award separate grants. In FY 1994, EPA awarded \$2.8 million and NIOSH awarded \$500,000. In FY 1995, EPA awarded \$1.55 million. NIOSH did not make any awards in FY 1995 because funds were not appropriated. No funds have been appropriated for subsection 1033 (b) which requires NIOSH to assess the efficacy of the worker and supervisor training programs developed by the grantees.

Subtitle D. Research and Development

This subtitle requires HUD, in cooperation with other Federal agencies, to conduct research on: (1) strategies to reduce the risk of lead exposure from such non-paint sources as exterior soil and lead dust in carpet, furniture and forced-air ducts (section 1051), and (2) testing technologies, including improved methods for evaluation of lead-based paint hazards in housing and assessments of the effectiveness of hazard evaluation and reduction activities funded by Title X (section 1052). HUD has completed several of these projects and has several research projects underway in cooperation with EPA, NIST, CDC, the National Center for Lead-Safe Housing, the University of Cincinnati and the National Institute of Building Sciences.

- HUD and EPA sponsored a field evaluation of chemical test kits and portable x-ray fluorescence (XRF) analyzers for detection of applied lead-based paint. The Technical and Summary reports, "A Field Test of Lead-Based Paint Testing Technologies", were published by EPA in May 1995 (EPA 1995a). See Part 3 of this report for a description of the results of this field evaluation.
- HUD and EPA developed Performance Characteristics Sheets (PCSs) that describe the performance of an XRF on real world paint surfaces, which were archived from the XRF study described above. The PCS describes how to control various sources of error for each different commercially-available XRF device. These PCSs are being used by inspectors across the country and are an integral part of the lead paint inspection protocol developed by EPA and HUD. PCSs are available from the National Lead Information Center.
- Under a grant from HUD, the National Institute of Standards and Technology is developing a standard XRF evaluation test to enable third party laboratories to evaluate XRFs. The project involves the development of a set of painted panels that any lab could replicate and use to evaluate XRF performance.
- HUD sponsored a study by the National Center for Lead-Safe Housing and the University of Rochester School of Medicine on the relationship between lead in house dust and blood-lead levels in children. Environmental, biological, socioeconomic and demographic data were collected for 200 urban children aged twelve to thirty months who have lived in the same dwelling since age six months or younger. The results of this study were published in June 1995 (Lanphear 1995). Refer to Part 3 of this report for a full description of the study.
- HUD is presently evaluating the cost and effectiveness of alternative hazard reduction methods used in the HUD Lead-Based Paint Hazard Reduction Grant Program. Data are being collected on lead in paint, dust, soil and children's blood prior to hazard control interventions. Effectiveness will be measured by changes in blood lead and dust lead at 6, 12, 24, and 36 months after intervention. Cost will be measured through the contractor's price. The National Center for Lead-Safe Housing designed the evaluation and is responsible for its overall coordination, with the assistance of the University of Cincinnati Department of Environmental Health. As of September 1996, 2,564 housing units had been enrolled in the evaluation. Final results will be reported in 2000. Interim reports are being prepared in February of each preceding year, starting in 1996.
- HUD and the Centers for Disease Control and Prevention (CDC) have entered into an interagency agreement to jointly finance a primary prevention demonstration grant program to control lead-based paint hazards for children living in high-risk housing. The three (3) year project will use a total of \$6 million in HUD funds to support

comprehensive and intensive neighborhood-based projects in Providence, Rhode Island and Chicago, Illinois. Neighborhood-based organizations and residents are collaborating with public and private organizations to create lead-safe areas for children and families living in Providence, Rhode Island's "Heart of Elmwood" community and the "West Town" area of Chicago, Illinois.

- HUD and EPA are evaluating the effectiveness of various cleaning agents in removing dust lead from different hard surfaces. A representative number of detergents were tested for their solubility of Pb-contaminated dust as a function of concentration of active cleaning agents, pH, surface tension, temperature, and hardness. The ability of detergents to remove lead contamination was studied using two types of soil composites and a number of different surface types. The expected completion date of the study is late 1996.
- The National Institute of Building Sciences (NIBS), supported by HUD, produced a technical manual in 1995 to facilitate the cost-effective and safe management of lead-based paint hazards associated with operations and maintenance activities in residential, public, and commercial buildings (NIBS 1995).
- HUD and EPA are developing a curriculum, instructor manual, student field guide, and teaching video for an eight-hour training course for maintenance personnel to learn the basics of lead hazard operations, maintenance, and interim controls. The course will identify operations and maintenance fundamentals, demonstrate approved practices, provide hands-on experience in implementing interim controls, and evaluate the learning achieved by students. The curriculum is expected to be ready for distribution in 1997.

- HUD is completing a study of lead-based paint hazards in HUD-owned single-family houses. The Single Family Property Disposition demonstration will (1) estimate the costs of compliance with proposed requirements under section 1013, and (2) provide information that will help HUD field offices in procurement and monitoring of contractors and services. The demonstration is expected to be completed in 1997.
- HUD entered into an interagency agreement with the Bureau of the Census to add questions regarding public awareness and lead hazard reduction activities to the December 1994 Current Population Survey. The survey sample is approximately 54,000 households; it will permit estimates of public awareness and lead hazard reduction activities for the 11 largest metropolitan areas and most States. The large sample size will also permit estimates of the level of awareness among low-income tenants with children. The results will form a baseline for comparison to data that will be collected after the section 1018 requirements become effective. This study was initiated in response to the requirement in section 1061 of the Act, which requires HUD to assess the effectiveness of section 1018 disclosure requirements in increasing awareness of lead-based paint hazards.

Section 1056 directs the Comptroller General to assess the effectiveness of Federal enforcement and compliance with statutory and regulatory requirements, including annual inspection procedures in Section 8 housing. The Comptroller General is also directed to study and report on the availability of liability insurance for property owners and contractors.

The GAO reports on lead inspection in Section 8 housing and liability insurance were completed in May and July, 1994, respectively.

Part 2: Results of Research Mandated by Subtitle D

Subtitle D directs HUD, in cooperation with other Federal agencies, to conduct research on strategies to reduce the risk of lead exposure and improving methods for evaluating and abating lead-based paint, and lead-contaminated soil and lead-contaminated dust in carpets, furniture and forced air ducts.

Lead-in-Dust Study at the University of Rochester

The Lead-In-Dust Study at the University of Rochester was developed by the National Center for Lead-Safe Housing, in collaboration with HUD, the Centers for Disease Control and Prevention, and the Environmental Protection Agency (Lanphear 1995).

The purposes of the study were: to determine whether dust lead loading ($\mu\text{g}/\text{ft}^2$) or dust lead concentration ($\mu\text{g}/\text{g}$) is a better predictor of children's blood lead levels; to investigate whether dust sampling using vacuum methods or a wipe method is more predictive of children's blood lead levels; to identify which interior household surface(s) should routinely be sampled for dust lead measurements; and to estimate the probability of a child having an elevated blood lead level on the basis of a known level of lead in house dust, controlling for other potential exposures.

Methods and Results. Identification and recruitment of eligible subjects was done by using lists of sequential births between March 1, 1991 and September 30, 1992 from three urban hospitals in Rochester, New York. Eligible children were in the 1 to 2½ year age range.

Stringent eligibility requirements were imposed to assure that the child's residential environment was the principal likely source of lead exposure. A cross-sectional study design was employed to investigate the relation of lead-contaminated house dust, other potential environmental sources of lead, and urban children's blood lead levels. Field work was done from August through November 1993.

Three dust collection methods were used to obtain side-by-side samples from as many as 12 sampling locations in each house (i.e., a maximum of 36 samples). Two vacuum methods were used to determine both dust lead concentration and dust lead loading: an in-line filter method (the Dust Vacuum Method), and a cyclone-type sampler with a much higher flow rate (the Baltimore Repair and Maintenance study vacuum method). Wipe sampling, which only measures dust lead loading, was also conducted. Thus, there were five dust collection method variables (Dust Vacuum Method dust lead concentration, Dust Vacuum Method dust lead loading, Baltimore Repair and Maintenance vacuum method dust lead loading, Baltimore Repair and Maintenance vacuum method dust lead concentration, and wipe dust lead loading).

In bivariate analyses, all five dust collection method variables on interior window sills, window troughs (wells) and carpeted floors, were significantly correlated with children's blood lead levels. Wipe dust lead loading and BRM loading on non-carpeted floors were significantly correlated with children's blood lead levels.

To determine which dust collection method measure was most predictive of children's blood lead levels, all five dust collection method variables were entered into the initial multiple regression model, along with all possible covariates which were significant in bivariate analyses. A backward selection process was used to eliminate non-significant covariates while all five dust collection method variables were simultaneously forced to remain in the model. In addition to the dust collection method, the following covariates were found to be significantly associated with higher blood lead levels among children: Black race, parental reports that children put soil in their mouths, single parent household, and a higher ferritin level.

Each of the five dust collection method variables were then entered individually into separate regression models along with significant covariates.

Dust lead loading using the Baltimore Repair and Maintenance vacuum sampler accounted for the largest amount of variation in children's blood lead levels compared with all other dust collection method variables. The partial correlations for the Baltimore Repair and Maintenance vacuum method dust lead loading and wipe dust lead loading with blood lead were not significantly different. On the other hand, the partial correlation for Baltimore Repair and Maintenance vacuum method dust lead loading and blood lead was significantly different than that for both Baltimore Repair and Maintenance vacuum method dust lead concentration and Dust Vacuum Method dust lead loading.

To determine which types of surfaces (i.e., interior window sills, window troughs (wells), non-carpeted floors, carpeted floors) were the best predictors of blood lead for each dust sampling method, the common covariates were forced into a model and the four surface variables were then allowed to enter through a forward selection process. For Baltimore Repair and Maintenance vacuum method dust lead loading, non-carpeted floors and window troughs were significantly associated with children's blood lead levels, whereas for wipe dust lead loading, non-carpeted floors and interior window sills were significantly associated with children's blood lead levels.

Using logistic regression to adjust for other significant covariates, the proportion of children estimated to have a blood lead level exceeding 10 µg/dL (micrograms of lead per deciliter of blood) was 4.3%, 15%, and 20% at 5 µg/ft², 20 µg/ft² and 40 µg of lead/ft² respectively, for non-carpeted floors using wipe sampling. Similar analyses are presented for carpeted floors, interior window sills and window troughs.

Conclusions. Dust lead loading is a better predictor of children's blood lead levels than is dust lead concentration for the range of lead-contaminated dust and blood lead levels observed in this study. Any household dust lead standard should be linked to the method by which dust is sampled, because the relationship between children's blood lead levels and

dust lead levels varies significantly by method of dust collection. The relationship between blood lead levels and household dust lead is different for floors, interior window sills, and window troughs using the same dust collection method, indicating that different standards are needed for each surface. To determine if a housing unit is safe for children, non-carpeted floors and interior window sills or window troughs can be measured using either the Baltimore Repair and Maintenance vacuum method or wipe sampling method.

Settled, lead-contaminated house dust (at levels observed in this study) is an important contributor of lead to children who have relatively low level elevation of the blood lead levels (i.e., blood lead levels up to 20 µg/dL). This study suggests that the proportion of urban children having a blood lead level exceeding 10 µg/dL increases at levels lower than current HUD post-abatement clearance standards and the EPA guidance levels. Future research should seek to confirm the estimated relationship between children's blood lead levels and lead contaminated house dust found in this study. Also, further research should investigate whether dust control is associated with a meaningful decrease in blood lead levels of children at today's lead exposures.

Field Test of Lead-Based Paint Testing Technologies

This project was funded by HUD and EPA and conducted by Midwest Research Institute and QuanTech (EPA 1995a). The study evaluated XRF instruments and chemical test kits. XRF instruments measure lead in paint by directing high energy X-rays and gamma rays into the paint, causing the lead atoms in the paint to emit characteristic X-rays, which are detected by the instrument and converted to a measurement of the amount of lead in paint. Chemical test kits detect the presence of lead in paint by a chemical reaction that occurs when chemicals in the kit are exposed to lead. This reaction causes a color change to occur if lead is present in the paint.

Key results noted in the report are:

- Laboratory analysis showed a wide range of lead levels at test locations throughout the study housing units that compared favorably with the distribution reported in the 1990 HUD National Survey of Lead-Based Paint in Housing.
- Lead levels appeared to vary significantly across the same painted surface.
- Test kits varied widely in their performance in classifying paint against either of the two federal thresholds that have been established to define lead-based paint on painted architectural components. The federal thresholds are 1.0 milligram of lead per square centimeter of painted surface and 0.5% lead by weight.
- K-shell XRF instruments were often effective in classifying paint samples against the federal threshold level of 1.0 mg/cm², when using an inconclusive classification range, laboratory confirmation, and substrate correction for quality control, as needed. Generally, L-shell XRF instruments had extremely high false negative rates, making them ineffective in classifying paint against the 1.0 mg/cm² threshold.

The primary XRF conclusion is that testing by K-shell XRF instruments, with laboratory confirmation of inconclusive XRF results, and with substrate correction in cases where this is effective in reducing bias, is a viable way to test for lead-based paint. This approach can produce satisfactory results for classifying the paint on architectural components using the federal threshold of 1.0 mg/cm². The XRF Performance Characteristics Sheets were developed based upon this field evaluation and testing conducted on archived painted substrates.

Further, the variability of lead concentration on the same surfaces of paint supports the conclusion that the most effective method of XRF testing of a single architectural component, such as an interior window sill, wall, or door, is to average readings at different points on the component. This finding was used by

HUD to change an older technique, which is to average a number of XRF readings taken at a single spot on the painted surface.

The primary test kit conclusion is that test kits should not be used for lead paint testing. Test kits cannot determine the extent of lead-based paint in a home and the need for protecting the occupants, especially when repairs or renovations are carried out. Homeowners and renters cannot be confident that test kits will discriminate accurately between lead-based paint and non-lead based paint. They should not make decisions on repairs, renovations or abatements based on test kit results. Because these kits are relatively inexpensive and could dramatically reduce costs of lead testing, further research and development is indicated.

Pilot Testing Program for Lead-Based Paint Encapsulant Protocols

Encapsulants are durable coating systems designed to cover existing lead-based paint, thus controlling the further deterioration of the paint and the resulting distribution of fine lead particles to household dust and exterior soil. The overall objective of this study by HUD and EPA was to evaluate the appropriateness of standard ASTM test protocols for assessing the performance characteristics of encapsulants for leaded paint. Specifically, the study was intended to:

- collect data to help determine the feasibility of a battery of test protocols drafted by ASTM E06.23.30 using both liquid coatings and reinforced liquid coatings;
- provide information that can support the assessment of existing minimum performance standards; and
- assess the variability of these test methods between two laboratories and within a single laboratory.

Several caveats were associated with this study which limit the extent to which the results and conclusions can be projected to other laboratories and coating products. First, this project was intended to evaluate the ASTM test protocols and not to evaluate the selected coating products. Second, only two laboratories participated in the testing of this project, and these laboratories were not chosen at random from the hundreds of U.S. facilities that could have performed the tests. Selection of the two participating laboratories was based on technical and cost factors; they were drawn from approximately ten firms which responded to a competitive request for proposals. Finally, only a limited number of coating products were tested in this project, and the products were not chosen at random, but instead were selected specifically to represent the range of products available in 1994. Because neither the products nor the laboratories were chosen at random, it is not possible to extend the results from this study to the broader population of products and laboratories available in the United States.

The overall study conclusions can be summarized according to each of the three project objectives stated above:

- The feasibility of testing was evaluated for 13 ASTM protocols or combinations of protocols, and in almost all cases the selected protocols were found to be feasible. The two notable exceptions where serious procedural difficulties were encountered were the pull adhesion test run after water immersion and the scrub resistance test run after weathering. Other difficulties were also experienced for some particular

combinations of test protocols and encapsulant products.

- Assessment of the 1995 draft ASTM minimum performance standards found five tests where draft standards were available. In all cases, the draft standards were found to be feasible because they fell within the range of all observed test results.
- Evaluation of testing variability between two laboratories and within a single laboratory focused on both product-to-product and panel-to-panel differences. As might be expected, the variability in test results was quite different depending on the particular protocol and products being tested. In some cases no variability was found (i.e., all test results were the same), while in other cases the standard deviation of the test data was more than 100 percent of the mean value measured.

The qualitative assessment of the test methods examined practical problems associated with conducting the protocols on encapsulant products, as well as issues that could affect the ability of the methods to distinguish among different types of products based on test performance. Overall, most of the test protocols were found to be feasible for most of the encapsulants selected, although there were testing challenges in some cases.

Several states now use the data generated in this report to approve certain types of lead-based paint encapsulants, including Ohio, New Jersey and Massachusetts.

Part 3: Health and Environmental Studies on Childhood Lead Poisoning

This Part responds to section 1061(a)(2), which requires a summary of current health and environmental studies on childhood lead poisoning. Studies reported here include research sponsored by HUD, EPA, CDC, and recent research reported in *Neurotoxicology*, *Pediatrics*, the *Journal of the American Medical Association*, and *Archives of Environmental Contamination and Toxicology* and other journals.

Review of Lead Toxicity

Lead is a toxic substance that attacks many different body organs and systems. Unlike other metals such as zinc or iron, lead has no beneficial effects on the body. Lead is a ubiquitous environmental contaminant, largely due to the wide variety of past and present commercial uses. It is one of the best-studied toxic substances.

Neurological Effects

Of greatest concern is lead's effect on neurological development and behavior. Although the precise mechanism of action is not yet fully understood, it appears that lead interrupts and inhibits neural differentiation, pathway development and learning abilities. Because learning acuity is high in the early years, interruptions in normal development in young children produces lifelong decreases in intelligence, suggesting that some effects of childhood lead poisoning are irreversible.

A recent review of a number of prospective, cross-sectional and retrospective epidemiological studies showed statistically significant inverse relationships between blood lead levels and IQ or other measures of cognitive development. At population averages, it appears that there is a decline of 2-4 IQ points for each increase in blood lead level of 10 µg/dL, although some studies suggest that the decline may be as high as 8 IQ points/10 µg/dL (Schwartz 1994a; Bellinger 1987; Bellinger 1992; Davis 1993). While this appears at first glance to be a rather small effect,

it is much larger at the ends of the population distribution. In other words, for those with IQ's below 80 or above 120 (i.e., children who are retarded or gifted), the effects are extensive.

The Agency for Toxic Substances and Disease Registry (ATSDR) estimates that lead exposure doubles the number of children with low IQ's, increasing the need for special education and other expensive compensatory programs. (ATSDR 1988b). Similarly, the sharp decline in the number of lead-poisoned children with IQ's above 120 means that lead poisoning can be associated with an absence of exemplary students and leaders in at-risk populations.

For lead-poisoned children with blood lead levels of 30 µg/dL, the predicted loss would be anywhere from 6 to 24 IQ points. Importantly, all of these studies, now numbering about a dozen, show declines in intelligence, regardless of whether or not exposures were high or low (Yule 1984; Bellinger 1987; Fulton 1987; Landrigan 1985; McMichael 1988; National Academy of Sciences 1994). While a few studies did not reach statistical significance, it is noteworthy that *all* the studies showed declines in intelligence (Davis 1993); that is, there have not been any studies suggesting that there was an *increase* in intelligence as a result of lead exposure. If lead truly had no effect (or only a very small one), one would expect to see the results of these studies to be distributed in either direction due to random chance alone.

While intelligence is a difficult characteristic to measure reliably, there are similar findings for cognitive function, language and reading skills, Mental Development Index scores, school progress, and visual-spatial and visual motor skills (eye hand coordination) (National Academy of Sciences 1994).

Unlike lead sources such as food or gasoline, which are typically associated with moderately increased blood lead levels, ingestion of lead-based paint can

produce greatly elevated blood lead concentrations among young children. If blood lead concentrations exceed 30 $\mu\text{g}/\text{dL}$, the loss of intelligence becomes more severe and is accompanied by additional neurological trauma. Long-term neurological outcomes among clinically poisoned children include retardation and severe behavioral disorders, seizures, cerebral edema, structural derangement in capillaries and neuronal necrosis (Pentschew 1965) (Perlstein and Attala 1966).

Lead concentrations in teeth are thought to be a better measure of long-term lead exposure than is blood lead level. Dentin lead levels have been associated with decreased reading ability and a greater likelihood of failing to graduate from high school (Needleman 1979). Another tooth lead study asked teachers to rate a series of performance measures including degree of organization, daydreaming, ease of distraction, persistence, impulsiveness, reading, hyperactivity and other similar measures of behavior. For each of these behaviors, there was a clear dose-response relationship between tooth lead and adverse behavior. (Needleman 1990).

Studies have linked lead exposure to anti-social behavior, juvenile delinquency and adult criminality (Thomson 1989; Fergusson 1993; Satterfield 1987; Denno 1990; Needleman 1996).

Of course, many of these neurological and behavioral effects could be explained by other environmental or genetic factors or lifestyle variables, such as nutritional status, parental involvement, or socioeconomic status. While each of the studies cited above used carefully constructed control groups that were alike in most respects except for lead exposure, confounding influences are a significant problem in human studies. Such factors are not present in animal studies, which have shown a clear association between lead intake and decreased size of neurons and dendrites, decreased complexity of dendritic processes, delayed synaptogenesis in the cerebral cortex, retarded development of neonatal cerebellar neurons, necrosis of mitotically active precursor cells, and reduced production of myelin (all reviewed in National Academy of Sciences, 1994).

Animal studies have also helped reveal plausible mechanisms of the link for between adverse behavior and lead exposure. For example, infant rhesus monkeys given low doses of lead showed disruptions in social behavior (Laughlin 1991). Lead is known to interfere with neurochemical inhibition in rodents (Taylor 1978), which could in turn lead to rapid uncontrolled responses to stimuli, manifested as impulsiveness or aggression.

Reproductive Effects

In the developing fetus, lead has been associated with decreased size of neurons and dendrites, decreased complexity of dendritic processes, delayed synaptogenesis in the cerebral cortex, necrosis of mitotically active precursor cells and reduced accumulation of myelin. In the female reproductive system, lead has been associated with decreased fertility, increased rates of miscarriage and stillbirth, premature rupture of membranes, pre-term delivery, and decreased birth weight. Reproductive effects are not limited to women, however. In men, decreased libido, premature ejaculation, erectile dysfunction, decreased number of sperm, abnormal sperm shape and size, and reduced semen volume have all been shown to be caused by lead exposure (ATSDR 1988b; National Academy of Sciences 1994).

Acute Neurological Effects of High-Dose Lead Exposures

At higher exposures, encephalopathy, cerebral edema, neuronal necrosis, severe retardation, severe behavior disorders and death can occur (Byers and Lord, 1943; Perlstein and Attala, 1966; Rummo 1979). These effects are now relatively rare events, although 3-5 deaths from lead poisoning still occur each year (Staes 1995b).

Effects on the Cardiovascular System

Lead exposures also are associated with small increases in blood pressure and left ventricular hypertrophy, which has important implications for heart disease. If population blood lead levels were cut in half, 20,000 fewer heart attacks per year and

100,000 fewer cases of heart disease per year could be expected (Schwartz 1991).

Kidney Injuries and Other Effects

Kidney injuries can also be caused by lead exposure, causing reduced ability to reabsorb nutrients, increased blood levels of waste chemicals produced by cells, and scarring of the kidney (ATSDR, 1988a). Decreased stature and reduced hearing acuity have also been observed (ATSDR 1988b).

Relationship of Lead Distribution Within the Body and Long-Term Health Outcomes

A significant amount of lead that enters the body is stored in the bone for many years, which, together with the neurological effects described above, can also be considered to be yet another type of irreversible health effect. An equilibrium exists between relatively large bone lead stores on the one hand and the soft tissues and the blood stream on the other, where lead turnover levels are more rapid. Certain events such as immobilization, wasting illness, osteoporosis, and pregnancy can result in more rapid mobilization of bone stores into the bloodstream, where it again becomes available to the brain and other organs, exerting its harmful effects (ATSDR 1988b; National Academy of Sciences 1993).

Symptoms of Lead Poisoning

Effects on the nervous system are also evident in the symptoms associated with lead poisoning. Common presenting complaints at higher exposure levels include vomiting, crampy abdominal pain, pain in the muscles and/or joints, paranoia, depression, and aggressive behavior. More obscure symptoms include malaise, fatigue, headache, irritability, anorexia, and diarrhea or constipation. Diagnosis of elevated blood lead levels in both children and adults is rarely completed by analysis of symptoms alone due to low specificity and sensitivity, necessitating a blood lead test. Most lead-poisoned children do not exhibit any obvious symptoms and most cases go undiagnosed (CDC 1991).

The classic symptom of high lead exposure in adults is focal palsy and peripheral neuropathy (weakness in the extremities). Wrist drop and foot drop are the common presenting signs. A lead-poisoned person often cannot keep the hands extended fully for even a short period of time (Matte 1992).

Margin of Safety and Prevalence Rates

Perhaps the most telling feature of lead toxicity and exposure is the comparatively small range between “normal” exposures to lead, its fatal dose, and the large populations exposed. In young children, fatal blood lead levels are in the range of 100 - 150 µg/dL, depending on the child’s nutritional status, age, and other factors (ATSDR 1988b). The current level of concern established by the Centers for Disease Control and Prevention (CDC) and the American Academy of Pediatrics is 10 µg/dL, which is only an order of magnitude below the fatal dose.

The Health and Nutrition Examination Survey (NHANES III, Phase 1, 1988-1991) showed that average blood lead levels in children aged 1-5 years of age are currently 2.8 µg/dL. Overall, 1.7 million young children had blood lead levels of 10 µg/dL or greater (Brody 1994; Pirkle 1994). This represented 8.9 percent of all children between the ages of one and five years. Recently-published NHANES III (Phase 2) data indicate that the number of children above 10 µg/dL during 1991-1994 was approximately 930,000.

NHANES III (Phase 1) data show that blood lead levels in central city neighborhoods are substantially higher (Table 6). For example, 37% of young non-Hispanic black children living in central cities of large metropolitan areas have blood lead levels greater than 10 µg/dL. Among low-income children of all races, 16% have blood lead levels greater than 10 µg/dL. While prevalence rates appear to be elevated among urban, low-income minority populations, there is also evidence that prevalence rates in rural areas are higher than originally thought, and may be on the order of 20% (Norman 1994). As a result of widespread lead exposure and the absence of clear symptomatology associated with the

disease, both CDC and the American Academy of Pediatrics now recommend that virtually all children between the ages of 1 to 6 years have their blood tested for lead (CDC, 1992; American Academy of Pediatrics 1993), unless there are data in a given

geographic area showing that a more targeted screening approach is appropriate. CDC is expected to issue new guidelines in 1997 to better target screening efforts to at-risk populations.

Table 6
Percentage of Children Aged 1 to 5 Years
With Blood Lead Levels 10 µg/dL or Greater by Race/Ethnicity,
Income Level, and Urban Status: United States, 1988 to 1991

	All+, %	Non-Hispanic White, %	Non-Hispanic Black, %	Mexican American, %
Income level*				
Low	16.3	9.8	26.4	8.8
Mid	5.4	4.8	8.9	5.6
High	4.0	4.3	5.8	0.0§
Urban status±				
Central city, ≥1 million	21.0	6.1§	36.7	17.0
Central city, <1 million	16.4	8.1	22.5	9.5
Non-central city	5.8	5.2	11.2	7.0

+All includes race/ethnicity groups not shown separately.

*Income level was defined by poverty-income ratio (PIR) categorized as low ($0 < \text{PIR} < 1.30$), mid ($1.30 \leq \text{PIR} < 3.00$), and high ($\text{PIR} \geq 3.00$). Persons with missing information on income and not included in the analysis of income level.

±Persons with missing information on urban status are not included in the analysis of urban status.

§Estimate may be unstable due to small sample size.

Source: Brody DA, Pirkle JL, Kramer RA, Flegal KM, Matté TD, Gunter EW, Paschal DC (1994), "Blood Lead Levels in the US Population; Phase 1 of the Third National Health and Nutrition Examination Survey (NHANES III, 1988 to 1991)," *Journal of the American Medical Association*, 272, (4), July 27: 277-316.

Prevalence rates are of course dependent upon the blood lead level of concern. Although the current level of concern of 10 µg/dL is low compared with earlier public health advisories (60 µg/dL was the level of concern for acute effects as recently as the 1970's), it is at least 300 times greater than the body burdens estimated for pre-industrial native populations in North America (Ericson 1991; Patterson

1991). There is also evidence that adverse health effects occur at blood lead levels below 10 µg/dL (CDC 1991a). Although the level of concern may decline further in the future as additional research is conducted, it appears to be a reasonable benchmark on which to base public policy at this time.

In short, the margin of safety is far less for lead than for many other environmental toxicants. Death from lead poisoning has now become a relatively rare event due to improved medical management and targeted screening campaigns. Between 1979-1988 there were 139 lead-related deaths; most of these were among adults and three were children who reportedly had lead-based paint exposure (Staes 1995b).

The widespread nature of lead exposure and its narrow margin of safety make it unique among the environmental toxicants.

Sources of Exposure: Importance of Lead Paint Hazards

Sources of lead exposure are numerous due to the metal's widespread uses in commerce. Today, the main source of lead exposure for most children in the United States is lead-based paint that was applied to residential structures over much of the past century (ATSDR, 1988; CDC, 1991; National Academy of Sciences, 1994; Rabin 1989; Rabinowitz 1985; Jacobs 1994; EDF 1992). As lead-based paints gradually deteriorate, lead contaminates housedust and soil, where it becomes more available to young children. Levels of lead in paint, dust and soil can all be correlated with lead dust on children's hands and blood lead level (Bornschein 1987; Clark 1991; Duggan 1985; Farfel 1991; Lanphear 1995). Hand-to-mouth transfer of lead followed by ingestion appears to be the principal route of exposure, although severe cases of lead poisoning are still sometimes caused by pica (ingestion of non-food items, such as peeling lead-based paint chips or lead-contaminated soil).

The use of lead in residential housepaint was reduced during the 1950's (Clark 1991). Before then, residential paints often contained as much as 80% lead by weight in the dried paint film, despite early warnings dating back to the turn of the century that lead-based paint was responsible for lead poisoning in children (Turner 1897). It was not until the appearance of titanium and other substitute pigments that lead was gradually phased out.

Evidence of the Effectiveness of Controlling Lead-Based Paint Hazards in Housing

Studies of various types of lead hazard control methods and how well they protect the health of children, the public, and workers have not been compiled until recently (Staes and Rinehart 1995)(EPA 1995b). The studies show that carefully-executed hazard control methods are effective in reducing children's blood lead levels and/or the dust lead levels in their houses. Tables 7 and 8 show that blood lead levels appear to decline anywhere from 6% to 23% over a period of 6 months to a year following hazard control. Another study shows that an 84%-96% decline in dust lead levels can be maintained for at least 3½ years following abatement (Farfel 1994). Preliminary data from HUD's evaluation of the Round I Grantees also show that dust lead levels are 23-99% lower than pre-abatement levels, which means that children's exposures are being greatly reduced (NCLSH 1997).

Most of these studies (with the important exception of the HUD Evaluation study) were of lead-poisoned children and were not explicitly designed to quantify the primary prevention benefit of controlling exposures before blood lead levels increased. Because prevention of exposure would eliminate the bone lead storage phenomenon and irreversible neurological effects described earlier, the effectiveness of hazard control will be greater than indicated by these studies.

No study has yet been done of children born into lead-safe dwellings, making an accurate quantification of the benefits of exposure prevention difficult. Indeed, such a study poses significant ethical concerns (i.e., a control group would consist of children born into houses with the lead hazards remaining untreated). But it is evident that reliance on the medical model (i.e., treatment of houses following the appearance of a child who has already been poisoned) will fail to realize the full benefits of primary prevention. Title X charges HUD with the task of shifting the nation's strategy from a reactive, medical model approach to a preventive, housing-

based approach, while maintaining the existing blood lead screening programs to ensure that those children who are poisoned are identified and treated.

Not surprisingly, the degree of effectiveness varies with the baseline blood lead level (Swindell 1994; Aschengrau 1994). It appears that the extent of the blood lead decline is most pronounced when the

child's baseline blood lead level is already elevated. At lower blood lead levels, the decline is more modest, as expected. When the work is conducted without proper controls dust lead and blood lead levels often increase, sometimes dramatically (Staes and Rinehart 1995; EPA 1995b; Amitai 1991; Fett 1992; Fishbein 1981; Rabinowitz 1985; Swindell 1994).

Table 7. The Long-Term Effect of Lead-Based Paint Hazard Control as Measured by Dust Lead Levels.

	Baltimore traditional (Farfel, 1990)	Baltimore modified traditional (Farfel, 1990)	Baltimore experimental (Farfel, 1991)*	Baltimore follow-up (Farfel, 1994a)*
Intervention (using the Title X definitions)	Interim control without comprehensive clean-up	Interim control without comprehensive clean-up	Abatement	Abatement
Year of intervention	1984-85	1984-85	1986-87	1988-91
Number of dwellings	44	15	6	13
Duration of follow-up	6 months	6 months	6 - 9 months	1.5 - 3.5 years
Geometric mean dust lead loading ($\mu\text{g Pb}/\text{ft}^2$) by surface type:				
Floors:				
pre-intervention	251	288	520	251
at follow-up	316	316	56	37
% change at follow-up	26% increase	10% increase	89% decrease	84% decrease
Window sills:				
pre-intervention	1,338	1,803	4,610	1,041
at follow-up	1,543	1,636	409	102
% change at follow-up	15% increase	9% decrease	91% decrease	90% decrease
Window troughs:				
pre-intervention	† 15,504	† 18,283	29,437	14,221
at follow-up	12,474	24,892	1,004	604
% change at follow-up	20% decrease	36% increase	97% decrease	96% decrease

*Although these abatements were conducted before the HUD interim guidelines were issued in 1990, the abatements were comprehensive and include many of the guidelines provisions for worker protection, containment and clean-up.

†The traditional and modified traditional procedures did not address lead paint hazards in window troughs.

Table 8. The Long-Term Effect of Lead-Based Paint Hazard Control as Measured By Blood Lead Levels.

Intervention title (years implemented)	Duration of follow-up	Percent of children having follow-up in each study	Number of children in each study group	Source of lead targeted for hazard control*	Mean blood lead levels (µg/dL)		
					Pre- intervention	Decline at follow-up	Percent decline in blood lead level at follow-up
Baltimore traditional vs. modified (1984-85)	6 months post intervention	19%	29	paint	32.5	1.9	6%
Baltimore dust control (1981-82)	†	63%	14	dust	38.6	6.9	18%
			35	no treatment	38.5	0.7	2%
Boston Retrospective (1984-85)	8 months post intervention	52%	59	paint	35.7	10.2	29%
St Louis Retrospective (1989-90)	10-14 months post diagnosis	28%	37	paint	35	8.2	23%
			17	no treatment	35	4.2	12%
Worcester County retrospective (1987-90)	up to one year post intervention	68%	132	paint	25.9	4.8	18%
New York chelation (1989-91)	6 months post intervention	>90%	87	paint	27	6 §	22%
Boston three-city soil (1989-90)	11 months post intervention	98%	52	soil, dust, paint	13.1	2.44	19%
			51	dust, paint	12.4	0.91	7%
			47	paint	12.0	0.52	4%

* All of the paint hazards were treated with interim control procedures to stabilize paint hazards. The only study that fully abated a lead hazard was the Boston three-city soil study, where soil hazards were addressed.

† The cleaning was done twice per month for a 12 month duration, with concurrent follow-up

§ All the children in the New York study received provocative chelation, but did not undergo chelation treatment.

Despite numerous gaps in the data, sufficient evidence exists to show that lead hazard control interventions can be done safely if adequate cleanup and clearance are implemented.

Response to Poisoned Children

In June, 1992, the Lead Task Force of the Association of State and Territorial Health Officials conducted a CDC-sponsored survey of the directors of public health for each of the fifty States, in order to determine the extent and nature of elevated blood-lead level (EBL) surveillance activities throughout the United States. Of 48 respondents, 21 had implemented or were planning to implement CDC's revised guidelines within one year, 18 planned to phase in guidelines over several years, and nine had no plans to implement the guidelines. Of 46 respondents, 37 are coordinating prevention activities with housing and environmental agencies. Of 47 respondents, 19 maintain a system at the State level of monitoring health and environmental follow-up of children with elevated blood-lead levels. (CDC 1993).

Direct Exposure to Lead Paint

In another study, the medical records of 90 children younger than seven years of age with moderate to severe lead poisoning, and who were treated by the St. Louis Division of Health, were examined for evidence of lead-based paint chips in their intestinal tracts (McElvaine 1992). According to a radiologist's evaluation of radiographs that were made prior to chelation therapy, 14 percent had evidence of paint chip ingestion. These children had significantly higher blood-lead levels than those with negative radiographs. These results suggest a need for contin-

uing concern about the ingestion of lead-based paint, not just the ingestion of lead-contaminated dust.

Juvenile Delinquency and Lead Poisoning

The objective of a study conducted at the University of Pittsburgh Medical Center was to evaluate the association between body lead burden and social adjustment. The study, conducted among 850 boys attending public schools in Pittsburgh, showed that those with relatively high levels of lead in their bones were more likely to engage in aggressive acts and delinquent behavior than boys with less lead in their bones. Researchers measured cumulative lead exposure by a new, expensive form of X-ray that examined the children's shinbones. (Needleman 1996).

Although none of the children in the study had ever been diagnosed with lead poisoning, a direct relationship was found between the amount of lead poisoning in their leg bones and reports by parents, teachers and children themselves of aggressive and delinquent behavior. Even after taking into account other predictors of delinquency, such as maternal intelligence, socioeconomic status and child-rearing factors, such as the number of children in the family and the presence of two parents in the home, those with higher lead levels were more likely to engage in antisocial acts. Race and history of medical problems were also controlled as confounding variables. Delinquent acts in childhood have been shown in past studies to be strong predictors of criminal behavior later in life. The study breaks new ground, opening the possibility that some of the violence in our society could be the result of preventable environmental pollution by lead.

Part 4: Federal Assistance for Lead Hazard Evaluation and Reduction Activities

Section 1061(a)(5) of Title X calls for an estimate of the “amount of Federal assistance annually expended on lead hazard evaluation and reduction activities.” HUD estimates that the average annual lead-hazard-related expenditure of Federal assistance by HUD grantees and public and Indian housing authorities during fiscal years 1994, 1995, and 1996 is approximately \$107 million. Of this, approximately \$83 million per year was expended by housing authorities, \$15 million by grantees under the HUD Lead Hazard Control Grant program, and \$9 million by

grantees under the Community Development Block Grant program, the HOME program, and other programs administered by the HUD Office of Community Planning and Development. In addition, during the same time period the Department has spent directly approximately \$8 million per year on the treatment of possible lead-based paint hazards in HUD-owned housing. HUD has been unable to obtain information on expenditures by other Federal agencies.

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